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THE NIAGARA RIVER POLLUTION ABATEMENT PROGRESS - 1971

International Joint Commission-United States and Canada

Prepared for:

Environmental Protection Agency

August 1971

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POLLUTION ABATEMENT PROGRESS

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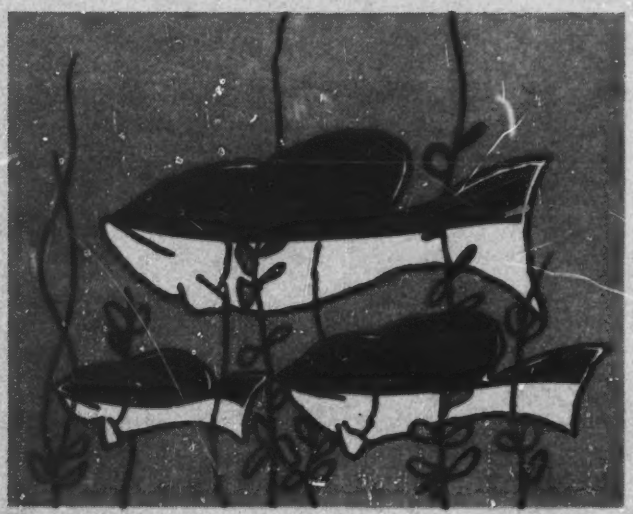

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LAKE ERIE - LAKE ONTARIO ADVISORY BOARD
INTERNATIONAL JOINT COMMISSION

SUMMARY REPORT

ON

POLLUTION ABATEMENT PROGRESS IN THE NIAGARA RIVER AREA

TO

THE INTERNATIONAL JOINT COMMISSION

This report has been prepared by the Lakes Erie-Ontario Advisory Board to the International Joint Commission on Control of Pollution of Boundary Waters. It is a summary of the pollution abatement progress that has occurred since 1967.

AUGUST 1971

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SUMMARY

There has been progress since 1967 towards pollution abatement in the Niagara Area which will ultimately be reflected by improved water quality in the Niagara River. Studies designed to develop regional systems in the counties of Erie and Niagara in New York State have been completed. The preliminary planning and studies needed to select the most appropriate treatment or control procedures for the municipal and combined municipal-industrial treatment facilities are either concluded or in the final stage. Some major facilities for waste treatment or control have been completed and placed in operation. The total anticipated improvement in river water quality will not occur until all of the planned abatement measures are completed and in operation. The limited number of projects completed and in operation have produced localized improvement but have not appreciably changed the overall quality of Niagara River water.

The Canadian waters in the Upper River generally meet the I.J.C. objectives. The concentrations of coliform and phenol exceed the objectives along the United States shore of the Upper River and throughout the Lower River. Areas of objectionable discoloration are still present in the vicinity of United States outfalls. Oil problems in the river have apparently decreased to a greater extent than the completed reductions of oil in effluents would be expected to accomplish. The publicity given oil pollution and the vigorous investigative and enforcement activities directed towards the numerous small potential waste oil dischargers such as gasoline stations has undoubtedly accomplished an undetermined but significant reduction of oil reaching the Niagara River. The improvement to date raises the hope that completion of the additional projected oil control measures will essentially eliminate oil problems in the river.

All of the municipal plants discharging to the Niagara River with the exception of Niagara Falls, New York instituted primary treatment and disinfection prior to 1967. Present treatment of wastes by Niagara Falls, New York is limited to fine screening and disinfection. All of the New York municipalities are proceeding to add secondary and phosphorus removal facilities. Almost all have completed or are finishing the needed pilot plant studies and are preparing the final construction plans. The Ontario program for phosphorus removal is proceeding along with the New York program. Compliance is expected by 1975.

The New York industries that originally decided to provide their own waste control measures have made significant progress, although they have not always been successful in meeting the established completion schedules. Some have completed waste control units which are being operated and evaluated as to their effectiveness. Each industry is required to provide the degree of waste reduction determined by New York State as adequate to protect the Niagara River and meet I.J.C. objectives. Most of the Canadian industries are in compliance with the requirements of the Ontario Water Resource Commission. The remaining ones are instituting the needed control measures.

Progress of the municipal and combined municipal-industrial waste treatment facilities has been slower on the United States side than anticipated or desired by the control agencies. Two industries which originally considered joining with the municipality but are now proceeding independently are also considerably behind schedule. The Comprehensive planning delayed starts of treatment plant construction but assure more orderly, efficient and effective sewerage and waste treatment systems for all political constituencies in the area. The pilot plant studies have enabled the selection of more effective and feasible treatment processes. The municipalities are now moving as rapidly as practicable. New York State's requirement that they be under construction by March 1972 to be eligible for construction grant funds is undoubtedly the stimulant.

In Ontario, modifications are being proposed for existing municipalities to keep pace with changes in civic organization and regional growth so as to improve sewage service as it relates to pollution control. Where improvements are being made to control existing pollution problems, the proposed schedules are satisfactory to the Ontario Water Resource Commission.

The cumulative effect of the waste treatment and control projects underway will markedly improve the water quality of the Niagara River by 1975. Except for a limited area downstream from the mouth of the Buffalo River, the bacterial quality of the waters will meet the proposed objectives. The phenol problem will be practically eliminated. Except in the case of an accidental spill, the river should be relatively free of oil films which collect in protected areas. A major step towards the needed reduction of phosphorus imputs to Lake Ontario will have been accomplished. Eyesores created by discoloration of the waters at waste outfalls will no longer exist and the overall appearance will be improved.

GENERAL CHARACTERISTICS OF THE RIVER AREA

Many adjectives have been used to describe the Niagara River. Common among those expressions used is the "mighty" Niagara. That it is, with flows that average 200,000 cubic feet per second. These tremendous flows midway in the 37 mile jaunt from Lake Erie to Lake Ontario suddenly plunge downward some 165 feet with a mighty roar creating one of the seven wonders of the world, Niagara Falls.

The falls divide the river into the Upper River and the Lower River. The Upper River leaves Lake Erie as a fast-flowing steam, then widens and forms two channels, moving more slowly around both sides of Grand Island. The upper half of the Lower River consists of widly flowing rapids and a picturesque gorge. From Queenston to the mouth, it flows more moderately to the mouth.

Man has harnessed this great natural phenomenon to generate power for his needs. The River is also the source for municipal water supplies serving 96 million gallons per day (MGD-U.S.) to 330,000 people in the United States and 11 (MGD-IMP) to a Canadian population of 75,000. The City of Buffalo municipal water plant, which obtains water at the junction of Lake Erie and the Niagara River, treats an additional 125 (MGD-U.S.) for a population of 530,000. More than 300 (MGD-U.S.) is pumped from the Niagara by United States industries. Bethlehem Steel and the Buffalo River industries take another 450 (MGD-U.S.) from Lake Erie at the head of the Niagara.

Tourism generated by the picturesque falls is a major industry of the area. Recreational boating is an extensive activity supporting a major industry in the area. Fishing, water skiing, swimming, and waterfowl hunting are also principal uses of these waters. The Black Rock Channel locks are maintained in the Buffalo area to permit considerable commercial navigation on the Upper River.

Municipal and industrial wastes from both sides of the border are discharged to the river. Because of the greater population and industrialization on the United States side, it contributes the giant share of the pollution in the river. Major industrial inputs to the river include chemical, steel, abrasives, paper, and oil refining. Dye manufacturing and alkali-chlorine production constitutes a significant portion of the chemical industry in the area. Many of these enter the Niagara indirectly through the normally slow-moving Buffalo River. The Buffalo River Stream Improvement Project was developed to increase minimum flow in the river and eliminate slug discharges of highly concentrated wastes that sporadically caused serious detrimental effects on the Niagara River.

WATER QUALITY OBJECTIVES

Water quality objectives have been recommended by the International Joint Commission for Lake Erie, Lake Ontario and the International Section of the St. Lawrence River and the connecting channels of the Great Lakes including the Niagara River. These update the objectives previously applied to the Niagara River as recommended by the IJC in 1951 in its Report on the Pollution of Boundary Waters.

The General Objectives are the goals of an effective pollution control program. The Specific Objectives are the desirable levels of water quality considered necessary at this time to achieve the General Objectives. Each Specific Objective has been developed in recognition of the appropriate restriction necessary to permit all legitimate uses of these waters. They constitute the parameters against which the effectiveness of provincial and state waters programmes can be measured.

The principal alternations in the objectives were made to provide for:

a. recognition of the nutrient and phosphorus pollution of the waters of the Great Lakes Basin.

b. the need for tighter controls on waste effluents and restrictions on mixing zones at outfalls.

c. increased restriction on several characteristics of water quality including the microbiology, dissolved oxygen content and taste and odour.

d. new restrictions on dissolved solids, temperature, phosphorus loadings and radioactivity.

The text of the new objectives contained in the 1970 report of International Joint Commission on Pollution of Lake Erie, Lake Ontario and the International Section of the St. Lawrence River follows.

WATER QUALITY OBJECTIVES
FOR LAKE ERIE, LAKE ONTARIO
THE INTERNATIONAL SECTION OF THE
ST. LAWRENCE RIVER AND THE CONNECTING CHANNELS
OF THE GREAT LAKES

GENERAL OBJECTIVES

The receiving waters of Lake Erie, Lake Ontario, the International Section of the St. Lawrence River and the Connecting Channels of the Great Lakes at all places and at all times should be:

a. free from substances attributable to municipal, industrial or other discharges that will settle to form putrescent or otherwise objectionable sludge deposits, or that will adversely affect aquatic life or waterfowl.

b. free from floating debris, oil, scum and other floating materials attributable to municipal, industrial or other discharges in amounts sufficient to be unsightly or deleterious.

c. free from materials attributable to municipal, industrial or other discharges producing colour, odour or other conditions in such a degree as to create a nuisance.

d. free from substances attributable to municipal, industrial or other discharges in concentrations that are toxic or harmful to human, animal or aquatic life.

e. free from nutrients derived from municipal, industrial and agricultural sources in concentrations that create nuisance growths of aquatic weeds and algae.

Furthermore, no substance should be introduced into these waters unless reasonable efforts have been made to ensure that it will not lead to the violation of any of the foregoing objectives.

SPECIFIC OBJECTIVES

The Specific Objectives are for the receiving waters except in the restricted mixing zones at outfalls. (The periphery of the restricted mixing zones should be prescribed by water pollution control agencies.)

a. Microbiology (Coliform Group) - The geometric mean of not less than five samples taken over not more than a 30-day period shall not exceed 1,000/100 ml total coliforms, nor 200/100 ml fecal coliforms in local waters. Waters used for body contact recreation activities should be free from bacteria, fungi, or viruses that may produce enteric disorders, or eye, ear, nose, throat and skin infections.

b. Dissolved Oxygen - In the Connecting Channels and in the upper waters of the Lakes not less than 6.0 mg/l at any time; in the hypolimnetic waters not less than the concentrations necessary for the support of fishlife, particularly cold water species.

c. Total Dissolved Solids - Less than 200 mg/l in Lake Erie, Lake Ontario and the International Section of the St. Lawrence River; in the St. Marys River, pending the results of a study of the Upper Great Lakes, a level of total dissolved solids not exceeding that of 1970; and in the other Connecting Channels a level consistent with maintaining the levels of total dissolved solids in Lake Erie and Lake Ontario less than 200 mg/l.

d. Temperature - No change which would adversely affect any local or general use of these waters.

e. Taste and Odour - No objectionable taste or odour. Phenols desirably absent but not to exceed a monthly average of 1.0 micrograms/l. Other taste and odour producing substances absent.

f. pH - No change from the range of levels, 6.7 to 8.5 which now exist.

g. Iron - Less than 0.3 mg/l.

h. Phosphorus* - Concentrations limited to the extent necessary to prevent nuisance growths of algae, weeds and slimes which are or may become injurious to any beneficial water use. (Meeting this objective will require that the phosphorus loading to Lake Erie be limited to .39 $g/m^2/yr$ and the phosphorus loading to Lake Ontario be limited to 0.17 $g/m^2/yr$.)

i. Radioactivity - Elimination of radioactive materials to the extent necessary to prevent harmful effects on health. Pending the adoption of more stringent limits, in no event is gross beta activity to exceed 1,000 pCi/l, Radium-226 not to exceed 3 pCi/l and Strontium-90 not to exceed 10 pCi/l.

Additional Specific Objectives - When required, appropriate Specific Objectives will be established for water quality parameters including but not restricted to toxic materials, oils and heavy metals.

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*The term phosphorus in this Report refers to phosphorus as a constituent of various organic and inorganic complexes and compounds, not to elemental phosphorus as a chemical substance. The term phosphorus includes orthophosphates such as trisodiumphosphate, crystaline phosphates such as sodiumtripolyphosphate, and polyphosphates such as sodiumhexametaphosphate. However, in this Report concentrations and loads are given in terms of the element phosphorus as part of any compound to assure uniformity of expression.

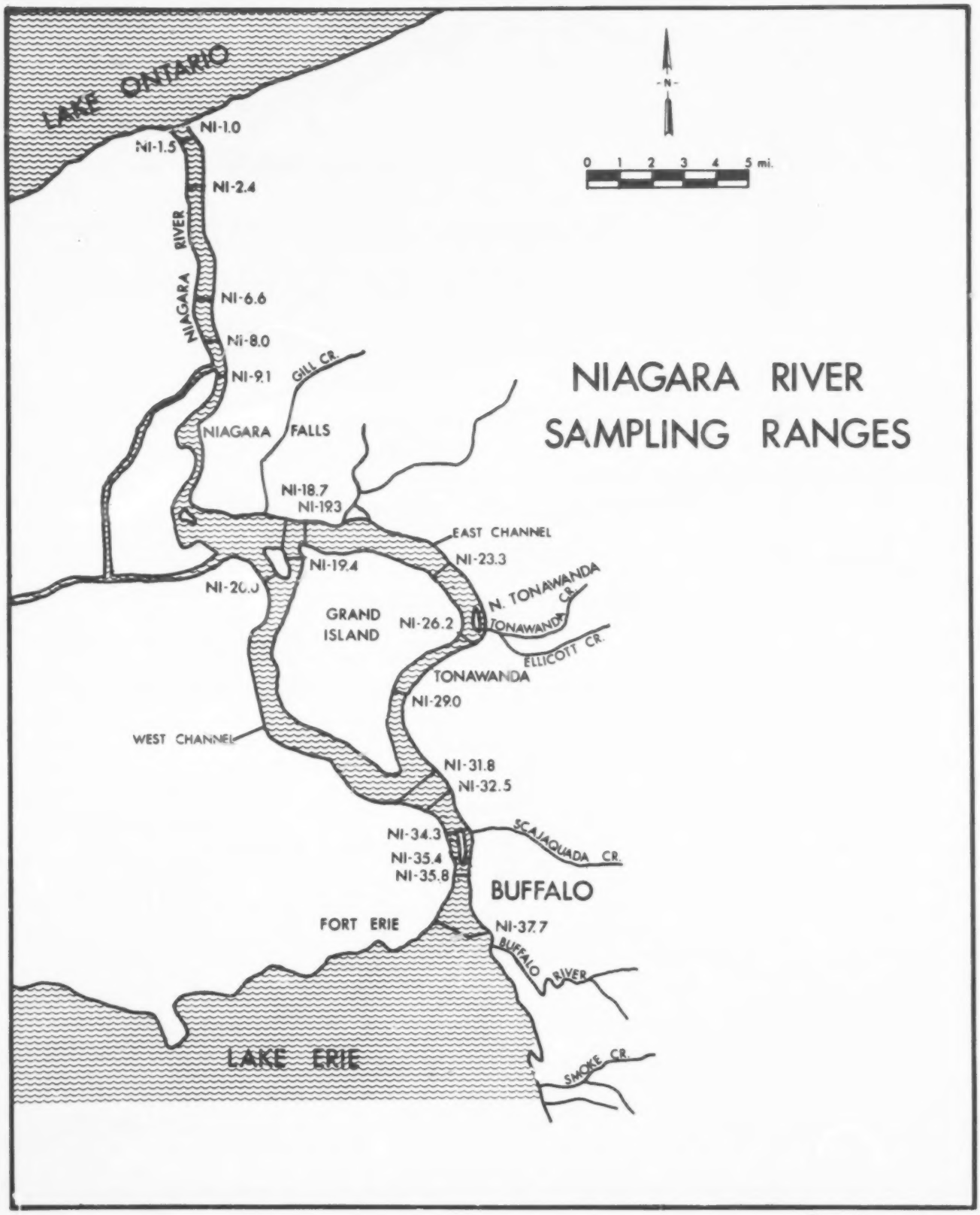

NIAGARA RIVER
SAMPLING RANGES
LAKE ONTARIO
NI-1.0
NI-1.5
NI-2.4
NIAGARA RIVER
NI-6.6
Ni-8.0
NI-9.1
GILL CR.
NIAGARA FALLS
NI-18.7
NI-19.3
EAST CHANNEL
NI-23.3
NI-19.4
NI-20.0
N. TONAWANDA
TONAWANDA CR.
GRAND ISLAND
NI-26.2
ELLICOTT CR.
TONAWANDA
NI-29.0
WEST CHANNEL
NI-31.8
NI-32.5
SCAJAQUADA CR.
NI-34.3
NI-35.4
NI-35.8
BUFFALO
FORT ERIE
NI-37.7
BUFFALO RIVER
LAKE ERIE
SMOKE CR.
N
0 1 2 3 4 5 mi.

Figure 1

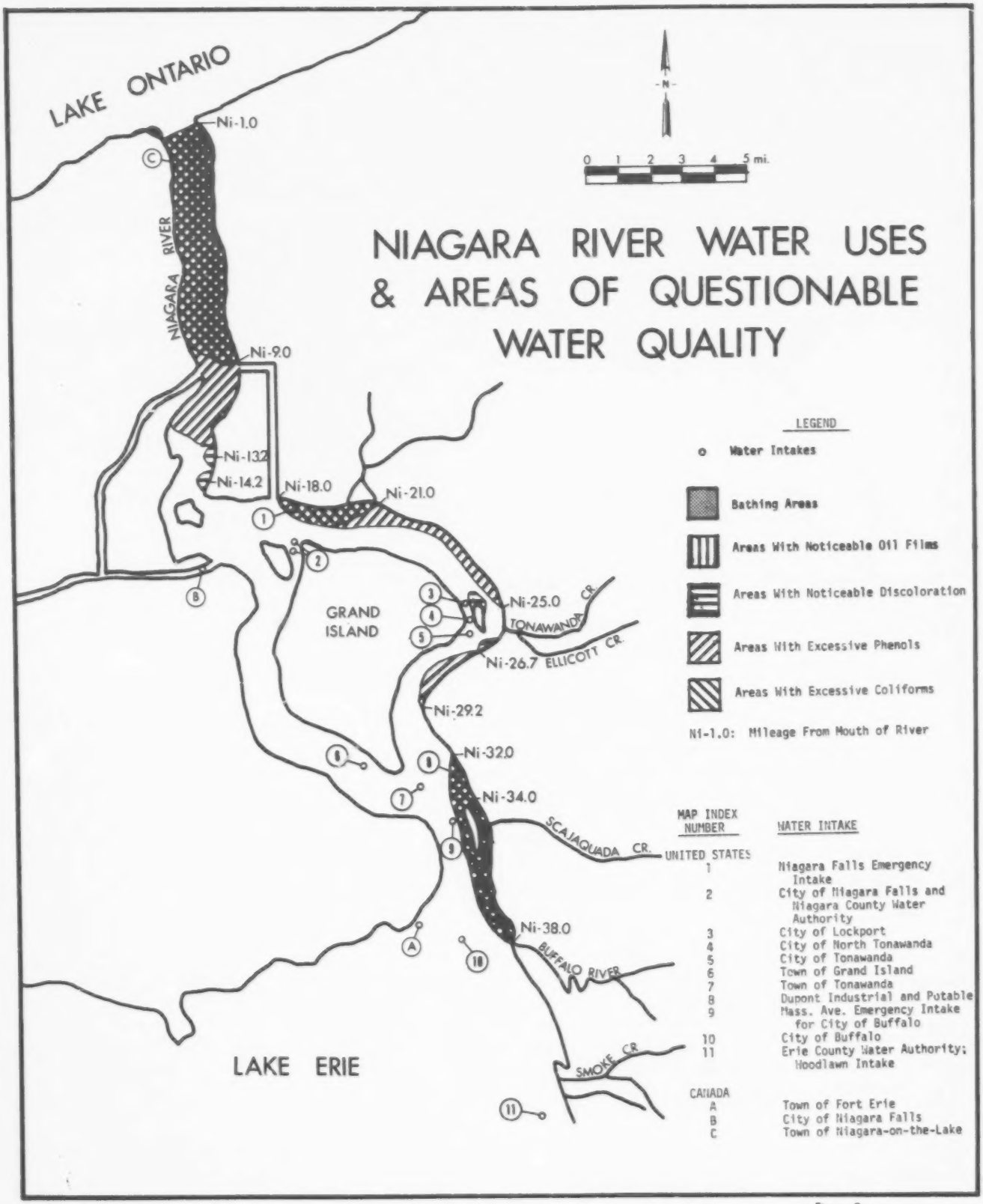

LAKE ONTARIO
Ni-1.0
NIAGARA RIVER
Ni-9.0
Ni-13.2
Ni-14.2
Ni-18.0
Ni-21.0
GRAND ISLAND
Ni-25.0
TONAWANDA CR.
Ni-26.7 ELLICOTT CR.
Ni-29.2
Ni-32.0
Ni-34.0
SCAJAQUADA CR.
Ni-38.0
BUFFALO RIVER
SMOKE CR.
LAKE ERIE
N
0 1 2 3 4 5 mi.
NIAGARA RIVER WATER USES & AREAS OF QUESTIONABLE WATER QUALITY
LEGEND
Water Intakes
Bathing Areas
Areas With Noticeable Oil Films
Areas With Noticeable Discoloration
Areas With Excessive Phenols
Areas With Excessive Coliforms
Ni-1.0: Mileage From Mouth of River
MAP INDEX NUMBER
WATER INTAKE
UNITED STATES
1 Niagara Falls Emergency Intake
2 City of Niagara Falls and Niagara County Water Authority
3 City of Lockport
4 City of North Tonawanda
5 City of Tonawanda
6 Town of Grand Island
7 Town of Tonawanda
8 Dupont Industrial and Potable
9 Mass. Ave. Emergency Intake for City of Buffalo
10 City of Buffalo
11 Erie County Water Authority; Woodlawn Intake
CANADA
A Town of Fort Erie
B City of Niagara Falls
C Town of Niagara-on-the-Lake

Figure 2

POLLUTION PROBLEMS IN THE NIAGARA AREA

There has been considerable progress towards pollution abatement in the Niagara River area. The comprehensive and much of the supporting detailed planning has been completed. Some of the major industrial facilities have been or are nearing completion. Reduction of the quantity of polluting materials and the expected improvement in the quality of the river water will not be fully realized until all the abatement measures and facilities are in operation. Some significant changes that have occurred are the marked decrease of observed oil pollution and elimination or reduction of localized discoloration in some areas.

In addition to the wastes entering the Niagara River directly, the discharges to the Buffalo River and to Lake Erie from the Buffalo-Lackawanna area markedly influence the Niagara River. They are considered in this report.

All available data have been reviewed in evaluating the present quality of the river. The Ontario Water Resources Commission has continued routine monitoring of the Niagara since 1967. Some of these data are presented in an appendix. The Commission also conducted a biological investigation of the river. New York State has maintained several monitoring stations along the U.S. shore. The U.S. Environmental Protection Agency, has collected data at the head and the mouth of the river. The sampling ranges are shown in Figure 1 and areas of water uses and impaired quality in Figure 2.

The recently recognized mercury pollution problem is present in Niagara waters. The quantity of mercury in industrial discharges to the river have been reduced to very low levels and efforts are continuing to accomplish the utmost reduction possible. All the water pollution control agencies are engaged in evaluating and seeking solutions to the various facets of this problem. All of the water pollution control agencies are engaged in evaluating and seeking solutions

Bacterial Contamination

Data collected since 1967 shows that the bacteriological quality of the Niagara River is approximately the same as it was in 1967. This is to be expected inasmuch as none of the corrective measures which will significantly reduce this type of contamination have been completed and placed in operation.

Current analytical results indicate that coliforms present in the waters along the U.S. shore of most sectors of the Upper Niagara exceed the revised IJC objective of a median value of 1,000 organisms per 100 ml of water. The median coliform levels found in the Canadian portion of the upper river was generally below a few hundred organisms and in no case exceeded 1000.

A major source of the bacteriological contamination of the U.S. side is the Buffalo River discharge. This river receives treated municipal waste and septic tank discharges in the upper reaches; septic tank effluent

from a limited area of the City of Buffalo and storm caused overflows from the Buffalo Sewer Authority combined sewers as well as other surface runoff. The above maintain consistently high coliform concentrations in the Buffalo River and the Black Rock Channel area.

All of the municipalities discharging wastes directly to the Upper Niagara provide primary treatment consisting of relatively effective sedimentation and chlorine disinfection of their wastes. The limited effect of the smaller volume Canadian municipal effluents is indicated by data showing the median coliform concentrations are generally below 100 organisms/100 ml in the Canadian waters of the Upper River. The larger U.S. communities of the City of Buffalo, Town of Tonawanda, City of Tonawanda and the City of North Tonawanda, noticeable increase the coliform concentrations in the river below their waste treatment plant outfalls. The effect is cumulative to the extent that the coliform residuals from an upstream effluent are not entirely dissipated before the next effluent enters the river. The net effect is median coliform concentrations over 1000 organisms/100 ml downstream of each outfall, but within the previous objective and New York States legally enforceable standard of 2400 ml/100 ml below most.

The Buffalo River discharge is the source of the coliforms identified near the U.S. shore of the main Niagara River Channel at the Peace Bridge range (Ni-35.8). The median coliform concentration 100 feet from the U.S. shore at this range is approximately 2000 to 3000 organisms/100 ml. It is below 100 organisms/100 ml beyond 500 feet from the U.S. shore.

The Buffalo River and the City of Buffalo sewage treatment plant effluents are the source of a median concentration of 4000 to 5000 coliforms/ml near the U.S. shore at range Ni-34.3, and 3000 to 4000/100 ml at range Ni-32.5. The concentrations drop off rapidly to less than beyond 1000 feet from the U.S. shore.

Another significant source of coliforms is the Cayuga Creek discharge. Septic tank effluents and some raw sewage enter Cayuga Creek from a limited area of Niagara Falls and rural and suburban areas of Niagara County. Some of this is the result of illegal connections to the City of Niagara Falls storm sewers which are being identified and eliminated by the City. The median coliform counts across the east channel about two miles downstream of Cayuga Creek at range Ni-19.3 has generally been about 3000 mg/100 ml, but have been significantly higher at times.

Dry weather contribution from the other small tributaries are relatively minor. During periods of heavy rainfall the tributary, storm sewer and combined system overflow discharges markedly increase the river coliform concentrations in the river.

The coliform concentrations in the Lower Niagara River are uniformly distributed across the river in the sector extending from Lewiston to the Mouth. The median concentrations found in this sector ranged from 1000 to 3000 per 100 ml. This is about the same as was present in 1967. The sources of these coliforms include the residual contamination coming

from the upper river and the discharge from the City of Niagara Falls, New York sewage treatment plant which currently provides only fine screening and chlorination of its mixed industrial and sanitary wastes. Other sources affecting the lower river are the Niagara Falls, Ontario and Lewiston, New York, sewage treatment plants, untreated sanitary wastes from the Niagara University Campus and combined and separate storm water overflows.

Phenol Problem

Phenol data collected since 1967 show about the same conditions in the Niagara River as existed in 1967. The recent information shows that the water near the U. S. shore of some sectors of the upper river continue to contain phenol which at times exceed the former IJC objective of a maximum of 5 ug/l and/or the average of 2ug/l, as well as the revised objective of an average of 1 ug/l.

One such sector extends approximately 5 miles downstream from the mouth of the Buffalo River. The principal source of this phenol is Buffalo River industries including the Mobil Refinery and the Donner Hanna Coke Plant. The Coke plant and refinery have reduced their phenol discharge since 1967. This reduction plus the dilution provided by the Buffalo Stream Improvement Corporation project, probably accounts for the significantly lower phenol concentrations found in the lower Buffalo River in 1970 compared to results obtained prior to 1967. The project placed in operation in 1967, increases flow in the Buffalo River by pumping Lake Erie water to five large industries which is discharged to the river after use. A comparable reduction of phenol in the Niagara River below the mouth of the Buffalo is not apparent from the available data.

Phenol concentrations slightly above both objectives continue to persist along the U. S. shore extending from river mileage 29 to 26.2. These are attributed to Semet Solvay Coke Plant and Ashland Oil Refinery effluents. The refinery has accomplished significant reduction of waste phenol losses since 1967. Phenol concentrations considerably above both objectives extend along the U.S. shore from the Hooker Chemical Durez Division Plant waste discharge (Ni-25.0) in North Tonawanda to the City of Niagara Falls, NY

The Canadian waters of the Upper Niagara River are essentially free of phenol. A number of samples collected in 1967 from the Canadian side of the boundary, but a considerable distance out from the Canadian shore, contained significant concentrations of phenol. It was recognized as an unusual condition at that time and could not be attributed to a specific source. Subsequent sampling show these sectors to be free of phenol as would be expected.

Phenol is uniformly distributed across the lower river in the sector extending from Lewiston to the mouth. Concentrations found since 1967 generally approach, but do not significantly exceed the former objective of a maximum of 5 and an average of 2 ug/l. The

Hooker and Varcum Chemical Plants in Niagara Falls are sources of the phenol in the City's sewage treatment plant effluent which have been significantly reduced. The Hooker Chemical plant also discharged some phenol directly to the river, but report all discharges were discontinued in January 1971.

It should be recognized that since about 1960, there have not been any incidents of taste and odor in municipal water supplies on the U.S. side which could be definitely attributed to phenol. The Town of Niagara-On-The-Lake requires continuous application of activated carbon to control taste and odor normally associated with the presence of phenol.

Oil

Although oils probably continue to cause more obvious damage to current uses of the Niagara River than any other single pollutant, observations indicate a marked improvement has occurred since 1967. The apparent improvement is greater than the known reductions of oil and grease in effluent discharges would be expected to accomplish. Bethlehem Steel, Republic Steel and Donner Hanna have already reduced oil losses. The Ashland Oil Refinery has placed a chemical feed air flotation oil removal unit on stream which recovers much of the residual oil in the effluent from the API separator.

Additional sources of waste oil discharges have been identified in the Buffalo area. New York State has required corrective measures in all cases.

It is probable that the tremendous publicity given oil pollution in recent years has had a significant effect. Many other industrial and commercial, including smaller unidentified sources, may have quietly taken action to reduce oil losses. There has been significant pressure on the automotive service stations in the Buffalo area to properly dispose of their waste oil. The cumulative effect of such activities undoubtedly accounts for some of the improved conditions.

The pressures on organizations to prevent oil spills and recover oil lost to the water has helped. Accidental oil spills continue to occur, but the responsible organizations are now more prone to immediately notify the official agencies. Actions to corral and recover the oil are becoming more prompt and effective. Rapid effective containment of on shore spills has in some cases prevented or minimized losses to the river. Where feasible, measures have been taken to either prevent a recurrence or contain the oil in the event of a similar future accident.

It is emphasized that although the problem has been reduced, it has not been eliminated. An indication of improvement is that duck hunters and banders generally report that the incidence of ducks found in the Niagara River with noticeable oil or grease spots (almost always lethal) on their feathers, is negligible compared to previous

years. Areas with observable oil films have been reduced. One example is immediately downstream of the Ashland Oil Refinery outfall.

In addition to continually discharging some oil to the Niagara, the Buffalo River continues to accumulate heavy surface oil films, that are discharged to the Niagara River during flood flows. These oils not only contribute to the total oil in the Niagara, but cause significant shore line coating and oil films in the Black Rock Channel area.

Iron

The concentration of iron exceeds the objective of 0.3 mg/l in some areas along the U. S. shore of the upper Niagara. It is consistently below this value on the Canadian side. The iron was generally uniformly distributed throughout the lower River with the average concentration somewhat above 0.3 mg/l.

Concentrations above the objective can cause red water problems in municipal water supplies. In extreme situations this causes staining of fixtures and clothes. The concentrations at all municipal water intakes are below 0.3 mg/l except at "Niagara-On-The-Lake", where it is only slightly above. Red water problems have not been reported by any municipal water plants.

Chloride

Chloride levels are not critical in the Niagara River. Recent data indicates that they are in the range of 26 to 28 mg/l at the head of the river and 2 to 3 mg/l greater at the mouth. This does not have any identifiable effect on current water uses. It is the historical trend that gives rise to some concern. Levels have increased about 18 mg/l since 1920 with 5 mg/l increase occurring since 1950. Chlorides are a part of the total dissolved solids in water that persist indefinitely.

The IJC has established the objective of not more than 200mg/l of total dissolved solids in Lakes Erie and Ontario. Lake Ontario waters are approaching this concentration.

Large quantities of chlorides are discharged to the Niagara River. A primary source of industrial waste chlorides is the concentration of alkali-chlorine manufacturing in Niagara Falls, NY, and certain other chemical plants. Removal of chlorides from wastes is a difficult problem. Hooker chemicals original solution was deep well disposal. They subsequently developed a process to recover a manufacture commercial hydrocloric acid from waste chlorides. Reduction of chloride losses through means such as water resue may be the only other feasible method currently available. Municipal waste treatment plant effluents and salt used for snow and ice removal from roads are also significant sources.

Phosphorus

The objective of reducing phosphorus imputs to the Niagara River is to combat the eutrophication of Lake Ontario. It has been estimated that the phosphorus input from Lake Erie is 4,500 short tons and the Niagara River drainage basin adds an addition 3,200 short tons annually to Lake Ontario. (Report of the Advisory Board to the International Joint Commission on the pollution of Lake Erie, Lake Ontario and the Internation Section of the St. Lawrence River-1969.)

About 2,300 tons per year are contributed by the combined Canadian-U.S. municipal treatment plant effluents discharged to the Niagara River. Industrial wastes add about 230 tons.

Esthetic Impairment of the Niagara River

The Continental Can Company in the City of Tonawanda ceased operations in December 1970 eliminating the objectionable appearance of the receiving water at their sewer outfall. There have not been any other changes since 1967 affecting the appearance of the Niagara River. Localized discolorations objectionable to the public continue to exist at the following locations.

A varied colored area, depending on the color of the paper pulp being produced, exists at the Spaulding Fibre effluent at mile point 26.7. Two effluent discharges of the International Paper Company in the City of North Tonawanda impair the appearance of the river at mile point 25.0. Two other conditions exist where they are prominently displayed to a large number of people. One is at the outfall of the City of Niagara Falls, NY diversion sewer, which was intended to carry cooling water and other relatively pollution free industrial waste water. This discharge is through the same outfall formerly used by the Adams Hydro plant. The tremendous dilution of the tail race water from the power plant masked any visual effects prior to its closing. Change in river flow patterns due to diversion of water by the Ontario Hydro and New York State Power plants probably has also accentuated the problem. Currently the effluent, containing suspended solids from Carborundum Company wastes enters at an eddy current which carries the gray colored waters upstream to the base of the New York State observation tower, and the "Maid of the Mist" landing dock. About one mile farther downstream (mile point 13.2) the City of Niagara Falls, New York, sewage treatment plant effluent markedly discolor an extensive section of the river. This is most prominently exposed to public view from Canadian side of the river. Both of the above conditions are seen by a large portion of tourists and others viewing the falls.

Just below the New York State Power Intake in the City of Niagara Falls, New York, at mile point 18.0, there is frequently a streak about 100 ft. wide of color slightly different than the river water. It extends about one or two miles downstream. It was assumed to be caused by calcium

in the Union Carbide plant wastes reacting with river water to form insoluble calcium carbonate. It is reported that investigations of the problem by Union Carbide indicate that other wastes discharged in the same vicinity also contribute directly or through interaction with Carbides wastes. Union Carbide has reduced the quantity of waste calcium discharged and expect to eliminate it by December 1972. The other wastes are also being reduced.

The Buffalo River water contains more color than Lake Erie water at the head of the Niagara. This frequently causes near shore water extneind a few miles downstream of the Buffalo River mouth to have a slightly different color than the main portion of the Niagara River. This is accentuated during above normal flow in the Buffalo when the apparent color due to turbidity is prominent. The projected improved waste control by Buffalo River industries is not expected to significantly change this condition.

It has been observed that the outflow from the New York State power plant is frequently much more turbid than the outflow from the Ontario Hydro plant. It is generally most noticeable during periods of rainfall and above normal flow in the upstream U.S. tributaries. Some people have theorized that U.S. waste discharges above the power are the primary cause. It is very doubtful that this can be substantiated.

It is believed that one major cause is that during above normal rainfall the turbid waters from the U.S. tributaries follow the shore and enter the New York State intake. The prevailing winds are towards the U.S. shore. It has been observed that significant on shore winds create a wave action picking up turbidity from bottom sediments and shore lines. This turbidity in the upper river carries into the New York State power plant intake, and re-enters the lower river at the power plant discharge. Some photographic evidence indicates that at times similar turbidity is present in the forebay of the Ontario Hydro plant.

A considerable amount of foam is generated below both the American and Canadian Falls. This foam is white when formed, but rapidly acquires an unsightly brown color. The flow pattern moves the foam towards the Canadian shore. Quantities collect and persist at the "Maid of the Mist" landing dock on the Canadian side which gives off a strong manure type odor that is objectionable to "Maid of the Mist" patrons. This foam is known to contain high concentrations of bacteria and other microbiological organisms. The odor and development of the brown color is undoubtedly due to the decomposition of the dead organisms, algae and other organic debris entrained in the foam.

Chemical type odors emanating from the diversion sewer outfall are frequently noticeable at the base of the New York State Observation Tower. This is also particularly objectionable because of the large number of tourists exposed to it.

Benthic Biology Of The Niagara River

During May and June 1968, the Ontario Water Resources Commission

conducted a survey of the bottom dwelling macroinvertebrates in the river. Some other investigations have been made of the Buffalo River and its influence of the biota at the head of the Niagara River, but this was the first study throughout the length of the Niagara.

The investigations conducted by J.L. Blum, Associate Dean of Sciences, University of Wisconsin - Milwaukee in 1963 and 1964, showed that the lower portion of the Buffalo River was devoid of benthos much of the time. Investigations have been carried out by R.A. Sweeney, Director, Great Lakes Laboratory at Buffalo, since 1967. These later studies indicated a slight improvement of the benthic population in the lower industrialized section of the Buffalo River, but further deterioration in upstream sectors compared to 1963-64 conditions. It has been suggested that the dilution provided since March 1967 by the operation of the Buffalo Stream Improvement projected has benefited the downstream sector.

The OWRC study showed that the benthic fauna population in the U.S. side of the Upper Niagara from the mouth of the Buffalo downstream to range 19.3, was dominated to a large degree by organisms such as sludge worms and pollution tolerant snails. On the Canadian side, the benthic population contained a large variety of clean water species including pollution sensitive mayflies, caddisflies, midge flies and amphipods. The impairment indicated along the U.S. shore of the Upper River is primarily due to both localized and cumulative effects of Buffalo River and direct waste discharges.

The effects of pollution throughout the Lower Niagara were indicated by the absence of mayflies, the scarcity of caddisflies and the restricted variety of species of sludgeworms and midge flies at most of the sampling locations. These conditions are attributed to waste materials from the upper river and those entering the river between the falls and Queenston. It is noted that the major discharge entering this sector is the effluent from the Niagara Falls sewage treatment plant.

Mercury - A New and Emerging Pollution Problem

Following the alert early in 1970 of the existence of a hazardous mercury water pollution problem, all of the official agencies expeditiously acted to identify and mitigate the conditions in the Niagara area. All known and probable mercury users were contacted relative to any possible loss of the metal or its compounds to sewers. Sampling and analyses for mercury content were performed in all cases where a significant loss to sewers was suspected.

It was learned that many industrial and commercial organizations use mercury. The chemical industry and laboratories frequently use appreciable quantities in gauges, manometers and thermometer wells. Many of these were unable to completely account for their mercury losses as indicated by replacement needs. It is probable that theft and spillage and breakage loss to floors and ground accounts for most. Users of

significant quantities for these purposes have tightened inventory control and improved safeguards for prevention of spills and breakage and containment of the metal when they occur. All organizations known or suspected of using mercury have been or are investigated when discovered. Included are paint manufacturers, feed company laboratories, paper manufacturing plants and others.

Four industries were found to have appreciable mercury losses to sewers. Buffalo Dye of Allied Chemical uses a mercury catalyst in the manufacture of a dye. The spent catalyst waste was discharged to the Buffalo River. New York State has prohibited this operation pending development of means to eliminate the mercury loss.

Great Northern Refinery in Niagara Falls, NY refined used mercury and recovered mercury from sludges provided by clients including mercury cell alkali-chlorine plants. Mercury was lost to the City of Niagara Falls sanitary sewers. The City ordered the company to cease all mercury processing until all loss from the operation can be accomplished. The plant experimented with recovery procedures designed to eliminate mercury waste discharge. They have subsequently ceased all mercury processing.

Hooker and Olin Chemical Companies operate mercury cell alkali-chlorine plants in Niagara Falls, NY. Both plants expeditiously proceeded to install temporary facilities and procedures in a major effort to comply with State and Federal requests to eliminate all mercury loss to sewers. Both have reduced their losses to less than one half pound per day. Most of Hooker's losses are discharged directly to the Niagara River. Most of Olin's discharge enters the City of Niagara Falls sanitary sewers with some to the diversion sewer.

Olin Chemicals is under a Federal Court Stipulation to reduce their discharge to less than one half pound of mercury per day and provide a schedule of proposed future reductions. Both Olin and Hooker have also submitted plans for reductions to New York State and are in the process of making the required permanent installations.

Mercury concentrations found in the City of Niagara Falls, NY Sewage treatment plant influent indicate the more mercury was reaching the plant than being discharged by the known sources. The City is sampling selected sewers in an effort to locate any additional waste mercury sources that may exist.

Analysis of Niagara River water shows that it generally contains less then the detectable limit of mercury. Deposition of mercury in the Niagara River sediments is generally limited to certain inshore areas. The rapid flow of the river prevents deposition of fine sediments in most sectors of the main stream. Sampling for mercury determination of inshore and Lake Ontario sediments at the river mouth was carried out by both the U. S. Environmental Protection Agency and the Ontario Water Resources Commission. The Canada Center for Inland Waters has carried out extensive investigations and is preparing a report on the distribution of mercury in Lake Ontario Sediments.

Mercury concentrations ranging from 2.0 to 5.0 mg/kg were found in Black Rock Channel sediments. The source of this mercury may be the past mercury waste discharge of the Buffalo Dye Plant to the Buffalo River. The material dredged from this channel is placed within a diked area.

The concentration found in the lower river sediments ranged from 0.0 to 5.6 mg/kg. The concentrations in Lake Ontario sediments on ranges extending out from the river mouth vary from 0.1 to 7.9 mg/kg. The higher values were obtained at approximately 6 miles into the lake which was the outer extremity of the sampling area. It is suspected that the mercury is sorbed onto the silt and clay particles which settle farther out into the lake.

Disposal of Dredged Material

The sediments dredged annually by the U.S. Army Engineers from the Buffalo River and the Black Rock Channel Area above the locks have been classified as polluted. These materials are either placed within the pilot study diked area or the more recently developed Times Beach area. Both areas are within the Buffalo Harbor. Investigations to date indicate that the polluting substances are effectively contained within the dike walls constructed of steel plant slag. Dredgings from the Buffalo Harbor which are less polluted and the downstream sector of the Black Rock Channel and Tonawanda Harbor which are relatively clean, are currently deposited in Lake Erie. Efforts are underway by the Army Engineers to develop agreements with local officials and others needed to develop additional diked disposal areas for future dredgings including those from Buffalo Harbor.

PROGRAMS IN EFFECT TO ABATE POLLUTION IN THE NIAGARA RIVER

NEW YORK STATE

The problems of water pollution has continued to receive top priority by the administration and the people of the State of New York. The Pure Waters Program now entering its sixth year reflects this concern. Steady progress has been made in achieving positive action in spite of the enormous complexity of the problems faced. Many changes have taken place since the 1967 report including the transfer of the Division of Pure Waters and its administrative responsibilities for the water pollution control program from the State Department of Health to the newly created State Department of Environmental Conservation. The following sections summarize the status of the various features of this program.

Enforcement

There are a total of 44 identified or anticipated municipal, industrial and institutional wastewater sources discharging 960 mgd of wastewater into or affecting the waters of the Niagara River. Thirteen of these representing 83 mgd are considered insignificant or abated either by construction of waste treatment facilities, connection to municipal sanitary systems or because they ceased operations. Another eight sources accounting for 553 mgd of wastewaters have abatement projects under construction or treatment facilities in operation. These figures include Bethlehem Steel, Republic Steel, Donner Hanna and Mobil Oil which are located on Lake Erie or the Buffalo River. Under final or preliminary design are 18 sources with 307 mgd of wastewaters. An additional five sources at 17 mgd are in predesign phase with engineering reports under preparation.

These statistics illustrate that the major portion of the wastewater sources are well along in the implementation of their abatement programs. There has been only one instance so far, where Attorney General action has been necessary. This action resulted in a $10,000 fine to Mobil Oil Company and issuance of a court ordered schedule to abate pollution.

Comprehensive Sewage Studies

County-wide studies in Erie and Niagara counties have been completed at an overall cost of $727,000. Implementation of master plans are underway in the following areas:

Buffalo Sewer Authority - The wastewater facilities report has been approved by New York State and EPA and a federal grant offer has been made; completion of final design expected by mid-September of 1971.

Niagara Falls (C) - Wastewater facilities report and application approved by New York State and under EPA review; final design in progress.

Grand Island SD #1 and #2 - Wastewater facilities report and application approved by New York State and under EPA review.

Tonawanda (T) - Wastewater facilities report conditionally approved by New York State, application under New York State review.

Tonawanda (C) - Same status as Tonawanda (T)

No. Tonawanda (C) - Wastewater facilities report being revised, possible change in scope.

Lewiston (T) SD - Wastewater facilities report and application approved by New York State and under EPA review; final plans submitted to New York State

Wheatfield (T) - Wastewater facilities report being revised; sewer district information approved by New York State Department of Audit and Control.

Porter (T) - Wastewater facilities report and application for collection system under New York State review.

All of the above projects will provide secondary treatment and phosphorous removal prior to discharge into the Niagara River.

Pure Waters Construction Grants

Currently, there are 11 municipal treatment works projects identified in the Niagara River drainage basin portion of Erie and Niagara counties. These projects are worth an estimated eligible project cost of $218 million of which New York State in guaranteeing $105.3 million and the Federal Government at least $25.5 million. In addition, the Buffalo Sewer Authority has retained engineering consultants to develop a three phase combined waste treatment program totaling an estimated $65 million of eligible project cost.

Incentive Programs

The emphasis currently placed on enforcement and construction is supplemented by continuing efforts to concurrently obtain maximum performance from existing waste treatment facilities. As an incentive to this objective, New York State communities may receive 33 1/3% reimbursement of their audited Operation and Maintenance expenses. Eligibility requirements include resolution by the governing body to comply with a specified time schedule for remedial action when necessary.

Since 1965, Operation and Maintenace grants totaling over $3,370,000 have been granted to six communities along the Niagara River including the Cities of Buffalo, Niagara Falls, Tonawanda and North Tonawanda and the communities of Grand Island (T) and Lewiston (V).

Under the Pure Waters Program, industry is offered the opportunity to build its own wastewater treatment plants and receive tax benefits. The tax relief incentives consist of the right to take a net operating loss deduction of the State income tax return in the year the expenditures are made and exemption of the treatment facilities from property taxes and special

levies. Industries building their own facilities must submit engineering plans to the Department of Environmental Conservation for review and approval. When construction is completed, the facility is inspected. If it is approved, a tax exemption certificate is issued. To date, certificates of compliance for tax benefits have been issued to the Chevrolet Plant, Division of General Motors in Buffalo for its pretreatment facilities and to the Bethlehem Steel Company for wastewater flows totaling 62.4 mgd.

Several industries along the Niagara River are taking advantage of the construction grant assistance available to joint municipal-industrial waste treatment facilities. These industries are indicated in Table III.

Surveillance

The New York State Department of Environmental Conservation maintains five active manual water quality surveillance stations on the Buffalo and Niagara Rivers. Samples are collected bimonthly and cover a wide range of parameters. In addition, an automatic monitor previously installed on Bird Island has been removed because of vandalism and is being relocated at the Town of Tonawanda water supply intake. The results of these sampling data have been interpreted and included in the previous section on water quality.

In addition to the stream surveillance, waste effluents are monitored by testing and measuring programs with periodic reporting to the Department. Industries included in this activity, either as an operating permit condition or under the auspices of the waste outlet registration program, are listed below;

Allied Chemical, Semet Solvay	
DuPont - Tonawanda	
Columbus McKinnon - Tonawanda	
Republic Steel - Buffalo	
Donner Hanna - Buffalo	
Ford Motor Company - Blasdell	ERIE COUNTY
Chevrolet - Tonawanda	
Bethlehem Steel - Lackawanna	
Niagara Mohawk - Tonawanda	
Ashland Oil - Tonawanda	
Olin Mathieson - Niagara Falls	
E. I. DuPont DeNemours - Niagara Falls	NIAGARA COUNTY
Union Carbide - Niagara Falls	
Hooker Chemical - Niagara Falls	

New Developments

Several legislative and administrative changes have occurred since the previous report of 1967. The most significant of these are summarized in the following passages.

Boat Pollution - Section 33-C of the N.Y.S. Navigation Law sets forth the prohibitions and requirements regarding liquid and solid waste discharged from watercraft. This law, effective March 1, 1970, empowers the Department of Environmental Conservation to promulgate boat pollution control rules, regulations and standards. Rules and regulations have been developed which identify the marine pollution control devices subject to approval, establishes minimum safety standards and requirements for approval of the devices and provides for retesting of devices as required by the State. Enforcement responsibilities of this law are assigned to the Division of Marine and Recreational Vehicles in the N.Y.S. Office of Parks and Recreation.

Several effluent standards have been developed for all sewage passed overboard from watercraft:

1. Removal of all readily visible floating and settleable solids.

2. Suspended solids less than or equal to 50 mg/l.

3. 5-day BOD and COD less than or equal to 50 mg/l.

4. A coliform median (MPN) in any number of samples must be less than or equal to 50/100 ml.

Phosphorus - A policy adopted in 1969 relating to phosphorus removal has been developed for the Lakes Erie and Ontario drainage basins including the Niagara River. Public exposire of these requirements was obtained through press releases and direct communications with municipal officials. This policy, in essence, calls for the removal of phosphorus at all municipal waste treatment plants receiving 1.0 mgd or greater to obtain an effluent phosphorus objective concentration in the range of 0.5 to 1.0 mg/l as phosphorus. The objective of this requirement is to reduce the total pounds of phosphorus originating from municipal and industrial sources in the drainage basin by an overall level of 80 percent. This policy for the Niagara River basin in effective immediately with attainment of objectives by December 31, 1975 for all discharges.

All municipalities along the Niagara River are providing for removal of phosphorus in the design of their waste treatment facilities. Legislation passed in 1971 requires labeling of all household cleansing products as to the percent content by weight of all ingredients. This law also prohibits after December 31, 1971, the sale of household cleansing products containing the excessive of 8.7% phosphorus by weight. A complete ban takes effect June 1, 1973, on all such products which contain more than a trace or incidental concentrations of phosphorus compounds.

Thermal Criteria - The standards for thermal discharges (heated liquids) to the waters of the State are "none alone or in combination with other substances or wastes in sufficient amounts or at such temperatures as to injurious to fish life ... or impair the waters for

any other best usage..." (6NYCRR 701.3 et seq.). Compliance of existing thermal discharges must be evaluated with respect to compliance with criteria adopted in July of 1969 and on file in the office of the Secretary of State. It is encumbent upon the applicant or discharger to demonstrate compliance with water quality standards including the thermal criteria for all new or modified thermal discharges.

The newly adopted criteria cover fresh water lakes and streams supporting trout or warm water fish species. Additional criteria applicable to coastal waters and estuaries are also provided. For the waters of the Niagara River, the criteria pertaining to non-trout fresh waters would be applied to all new or modified thermal discharges.

These criteria require that the water temperature at the surface of the river shall not be raised to more than 90°F at any point. Further, at least 50 percent of the cross-sectional area and/or volume of the flow of the river including a minimum of one-third of the surface as measured from shore to shore shall not be raised to more than 5°F over the temperature that existed before the additional of heat of artificial origin or to a maximum 86°F, whichever is less, except during periods of the year when stream temperatures are below 39°F. For the protection of aquatic biota from severe temperature changes, routine shutdown of an entire thermal discharge at any site should not be scheduled during the period from December through March.

Lateral Sewer Construction Aid - Chapters 1045 and 1046 Laws of 1970, established a major new addition to the State's Pure Waters Program to assist rural communities whose local economics and tax bases are insufficient to bear the burdens of the cost of construction sewage collection systems. This law was amended by Chapter 1162, Laws of 1971, to incorporate the factor of need and to clarify eligibility of communities for assistance under this program. This law as amended became effective April 1, 1971. Rules and Regulations for implementing this program will be promulgated as soon as available. State aid under this program is estimated at $10 to $15 million per year.

Pesticides - The N.Y.S. Department of Environmental Conservation has imposed stringent restrictions on pesticides effective January 1, 1971. These include a complete ban on the use of DDT and nine other persistent pesticides and restricted use of another 62 pesticides. Pesticides completely banned include Bandane, BHC, DDD, DDT, Endrin, mercury compounds, selenites and selenates, sodium fluoroacetate, strobane, and Toxaphene.

These regulations, implementing legislation enacted last year, were developed following consultation with the State Department of Agriculture and Markets, the College of Agriculture and the Geneva Experiment Station to insure availability of less harmful chemicals and after a series of public hearings held throughout the State last summer. According to the regulations, supplies of the 62 restricted pesticides on hand in the State as of December 31, 1970, may be used by any person within the State until December 31, 1971, after which new supplies may be bought only by holders of "purchase permits" issued by the Department. The plan prohibits

importing pesticides into the State without a commercial permit while allowing one year to gradually deplete the inventory of restricted pesticides.

An estimated 10,000 applications for commercial pesticide permits are expected to be filed during the year in compliance with the requirements that each pesticide dealer submit a complete inventory of restricted pesticides in his possession as of December 31, 1970, with interim reports filed every three months through 1971.

Bulk Storage, Transportation and Handling of Hazardous Substances

Rules and regulations are being developed under the authority of the 1970 legislation which established the new Department of Environmental Conservation. The program will be administered by the newly established Bureau of Bulk Storage which will emphasize preventative measures to control accidental releases of oil and hazardous substances from the handling, transportation and storage of such materials.

They will spell out the preventive measures and equipment required by facilities involved in liquid handling and shipping and are based on needs as reflected in a record of spills and releases of liquids to surface waters in this State over the past four years.

Assembly Bill 5984-A, which established a State policy for the protection of the environment included under Article 2, Section 14, a provision to "prevent pollution through the regulation of storage, handling and transport of solids, liquids and gases which may cause or contribute to its pollution".

Assembly Bill 2955-A, also passed during the 1970 legislature, was an act to amend the Public Health Law in relation to storage of liquids likely to cause pollution of the waters of the State. The bill authorized the Department to "make, amend and repeal rules and regulations for the storage of liquids likely to pollute the waters of the State".

MUNICIPAL AND INDUSTRIAL POLLUTION ABATEMENT STATUS
NEW YORK STATE

Current information on the characteristics of the municipal and industrial waste discharges is shown in Table I. The status of the municipal waste treatment projects is given in Table II and the industrial abatement actions is presented in Table III.

A few industries are farily close to meeting the originally established completion schedules. All of the municipalities and many of industries are considerably behind schedule. Some factors which generally contribute to the delay follow:

a. Municipal treatment projects are required to comply with Comprehensive Regional plans to qualify for state and federal construction grant funds. The Erie County Comprehensive Sewerage Study and the Niagara County Comprehensive Study were not completed and adopted until October 1968 and October 1970, respectively. Most of the municipalities tended to proceed slowly with planning and investigation activities until the regional plan was formalized.

b. The regional plan in many instances, required that two or more governmental entities develop a joint project. Development of agreements between the political subdivisions was particularly time consuming. This also occurred in those cases where joint industrial-municipal waste treatment was being considered.

c. Many more pilot plant studies have been carried out than was originally anticipated. Pilot plant investigations were needed in those cases where the wastes contained a significant proportion of industrial waste and whenever joint treatment was considered. Pilot plant investigation of the proposed phosphorus removal processes have been required in all cases.

d. In those cases where joint treatment was being considered, the industries were unable to proceed with their own plans until the municipality had sufficiently defined treatment needs to enable them to make specific proposals.

Following is an extension of some comments in Tables II and III.

Buffalo Sewer Authority

Work was begun on an engineering report in 1968 which included some pilot plant work. In February 1969 the Buffalo Sewer Authority was informed that phosphorous removal must be investigated and included in their final design, this required additional pilot plant studies. An engineering report was submitted in January 1970. This report which included proposals for secondary treatment and phosphorous removal was approved by New York State in April 1970. A grant totaling $23 million for the project was approved by New York State in October 1970. Test borings have been carried out and final plans are being prepared with submission of Contracts I & II (of 5 major contracts) scheduled for August 15, 1971.

Town of Grand Island (S.D. #1 and S.D. #2)

A preliminary report on proposed facilities was submitted in April 1969. This report recommended the construction of one treatment facility to serve the present S.D #1 and S.D. #2. Because the adopted sub-regional plan of the Erie County Comprehensive Study recommended two separate facilities, more detailed cost estimates were needed to justify the construction of a single plant. A detailed wastewater facilities report recommending that one plant be built was submitted to the State on May 1970. The wastewater facilities report has been accepted by New York State (4/14/71). Final plans for Contract 1,2,&3 (of 7 total contracts) to be submitted August, 1971.

City of Lackawanna

The adopted sub-regional plan of Erie County Comprehensive Study recommends that the City of Lackawanna participate in a joint plan with the Town of Hamburg. However, Lackawanna wishes to retain its existing facilities with upgraded treatment provided. Preliminary discussions were held to discuss this problem but not until December 1970 did the City contract with a consulting engineer to prepare the necessary engineering report evaluating the two alternates.

Despite the fact that the City did little to provide secondary treatment and phosphorous removal, construction on a project to expand the Wilmuth Avenue Pumping Station (Main pumping station and preliminary treatment facilities) is approximately 95% complete. In addition, an engineering report for the Third Ward storm sewer separation program is presently being reviewed by the New York State Department of Environmental Conservation. A wastewater facilities report for treatment facilities will be submitted by August 20, 1971.

City of Niagara Falls

In late 1965 the City submitted an engineering report with a request for approval of eligibility for both State and Federal construction grant funds. The report provided for the equivalent of primary treatment with disinfection. Pilot plant studies had shown that an air flotation process could accomplish effective suspended solids removal in the very limited space available at the present plant site. Approval of the project was denied because New York State was establishing the policy requiring a minimum of secondary treatment.

The City's consultants subsequently proceeded with further investigations and considered some possible alternate solutions, including a separate industrial waste treatment facility. None of these appeared to be a feasible and adequate solution to the unusually complex waste treatment problem of this City. Factors such as lack of space at the present site and the high lift pumping required from the existing deep collection tunnels to an alternate site presented difficulties, but the major stumbling block was the fact that the usual secondary waste treatment processes were not effective for the mixed (75% industrial, 25% sanitary) wastes.

In December 1969, the City retained other consultants which proceeded expeditiously to investigate the feasibility of treatment by the relatively new physical chemical process. They determined the quantity and characteristics of each of the significant industrial waste discharges to the sanitary sewer system. They conducted pilot plant studies of the effectiveness of the air flotation and settling processes with and without coagulant aids for suspended solids removal followed by activated carbon filtration. The collection system studies resulted in the selection of a new single treatment plant with certain sewer construction designed to reduce the sewage pumping required. An engineering report was approved by New York State and submitted to the United States Environmental Protection Administration for grant eligibility review. Final plans for the Gorge Force Main were submitted August 1, 1971 and are under review by New York State and the Environmental Protection Agency.

City of North Tonawanda-Hooker Durez-International Paper-Tonawanda Iron

The City submitted a feasibility report for combined treatment of municipal and industrial wastes in April 1968. New York State recommended preparation of an engineering report based on the feasibility study. Numerous meetings were held to develop tentative agreements with the industries and to determine grant eligibility. The City then retained a new consultant in 1969 which introduced further delays. The engineering report, finally submitted in December 1969, was reviewed and returned by the State for development of additional data to substantiate the effectiveness of phosphorous removal. This required the pilot plant studies to be conducted in 1970. Investigation of the physical-chemical treatment process was concurrently conducted. A revised engineering report was submitted December 1970 and is presently under review by New York State. Because of the failure of the consultant to document his process selection the report has been returned for revision.

City of Tonawanda and Town of Tonawanda

The City and Town were informed by New York State in October 1968 to pursue a joint venture with Continental Can and Spaulding Fibre (as recommended in Erie County Comprehensive). A feasibility report describing such a venture was submitted in May 1969. In November 1969, the City and Town reached a preliminary agreement for pursuing a joint project. Numerous conferences were held to evaluate industrial contributions, grant eligibility and cost allocations. In November 1970 the City submitted a report describing collection and conveyance of wastes to the Town for treatment and disposal. A report by the Town describing treatment of wastes (including phosphorous removal) from the City, Village of Kenmore, Spaulding Fibre and the Town was submitted December 31, 1970; this includes the results of pilot plant studies made during 1970. The reports have been accepted by New York State. Final plans are now being prepared.

Hooker Chemicals-Niagara Falls Plant

The major efforts have been aimed at acceptable control of phenols, chlorides, solids, organics, mercury and pH. A deep well was drilled for the disposal of chloride, hydrochloric acid and some organic wastes. Installation of the deep well waste injection facilities were subsequently deferred to permit investigation of the feasibility of chloride recovery for hydrochloric acid production and development of a market for the product. This process was placed in operation early in 1971 and plans for deep well waste disposal have been abondoned. Five operations producing waste phenol have been permanently closed down. Waste solids, organic and alkalinity from the Trichloroethylene operation will be eliminated by its scheduled closing on January 1, 1972. Extensive facilities to divert 20 MGD of cooling water from the municipal sanitary sewers have been completed. Process modification and recycling has been emphasized, so as to minimize the direct waste treatment required. An additional 10 MGD will be discharged to the proposed Niagara Falls City system.

International Paper

The Company was committed to going with City and delays were encountered as mentioned above (City of North Tonawanda). For financial reasons, the Company decided in May 1970 to pursue an independent abatement project. A wastewater facilities report describing independent treatment facilities, submitted in August 1970, was approved by New York State in January 1971. The company is preparing final plans. Some site preparation and foundation work has begun.

Mobil Oil

Mobil Oil entered into a stipulation in March 1967 to close down the plant or start construction of treatment facilities by July 1968. A report describing a program of various in-plant changes and maintenance improvements was reviewed by New York State and returned to Mobil in February 1968. New York State requested that a more detailed engineering report describing the entire plant be prepared. In March 1969, Mobil claimed to have instituted various in-plant modifications, however, the report as requested was never submitted. In November 1969, Mobil was given specific effluent limits for ammonia and phenol discharges; once again a detailed engineering report was requested.

Due to lack of progress and failure to submit the requested reports, the case was referred in April 1970 to State Attorney General for enforcement action. As a result, a trial was held and a court order was issued (see Table III for schedule) and a $10,000 fine assessed.

The firm has complied with the Order. Construction was completed July 15, 1971; the facility is now in operation and under extensive evaluation.

Spaulding Fibre

The Company considered going with the City of Tonawanda in a joint project in 1968. After many delays, Spaulding Fibre committed themselves in October 1969 to discharging into a joint municipal system with the City and Town of Tonawanda. Delays since October 1969 are concurrent with the City and Town program. A report describing how flows and contaminant levels will be reduced by various inplant modifications and process changes is expected October 1, 1971.

TABLE I

MUNICIPAL & INDUSTRIAL WASTE SOURCES
AFFECTING THE NIAGARA RIVER FROM U.S.

Name Municipal	Flow (MGD)	Oxygen Demand (#/ day)	Solid Total (#/day)	Solid Susp. (#/day)	Extractables (#/day)	Others (#/day)	Remarks
Buffalo	160	136,272 B	105,500			Phosphates	
Grand Island S.D. #1	0.45	923 B	548		199	Phosphates	
Grand Island S.D. #2	0.27	310 B	90		53	"	
Lackawanna	3.6	21,600 B	17,100			"	
Lewiston	0.38	323 B	335		45	"	
Niagara Falls	84	46,300 B	232,200			"	
North Tonawanda	6.4	2,840 B	2,200		490	"	
City of Tonawanda	5.5	8,500 B	2,700		1,100	"	
Town of Tonawanda	12.8	7,950 B	8,600		2,220	"	
Cheektowaga #3	1.6	866 B	1,172		-	"	
Cheektowaga #5	6.8	2,314 B	2,823		-	"	

TABLE I

MUNICIPAL & INDUSTRIAL WASTE SOURCES
AFFECTING THE NIAGARA RIVER FROM U.S.

Name	Flow (MGD)	Oxygen Demand (#/ day)	Solid Total (#/day)	Solid Susp. (#/day)	Extractables (#/day)	Others (#/day)	Remarks
Allied Chemical Buffalo Chemical	9		in 12931 out 13725 net 794	1911 2787 876		Iron 94 Sulphate 649 Alkalinity 757	Average results of once per week sampling-August-November 1970.
Allied Chemical Buffalo Dye				None available		xxxxxx	Last available data from October 1967 not relavent now. Treatment works under construction for connection to Buffalo Sewer Authority
Allied Chemical Semet Solvay	11.8	5200 C		2047 net	281 net	Phenol 61 Cyanide 26.8 Ammonia 1802 temp. out 36°C. temp. rise 13°C.	Results for June-September 1970, once per week sampling
Ashland Oil	20				430	Phenol 25 Ammonia 1687	Results of weekly composite sampling for August-November 1970.
Chevrolet	To Niagara River 28.7 To Two Mile Creek 0.5			5914	2385	pH range 7.2-7.4 temp. range 80-91 °F temp. Avg. 86°F. pH range 7.4-7.7 temp. range 78-89°F temp. Avg. 84°F.	Average results for August-December, 2 grabs per day
Columbus McKinnon	0.2					temp. range 52-82°F. Avg. temp. 68°F.	Total of two outfalls reading 2/month for April-November 1970.

TABLE I

MUNICIPAL & INDUSTRIAL WASTE SOURCES
AFFECTING THE NIAGARA RIVER FROM U.S.

Name	Flow (MGD)	Oxygen Demand (#/ day)	Solid (#/day) Total	Solid (#/day) Susp.	Extractables (#/day)	Others (#/day)	Remarks
Donner-Hanna	7	297 B			64 net	Chlorides 6778 Phenol 16 Sulphate 1323 temp. rise 30°F	August results of once per week sampling for August-December 1970
Dupont Yerkes Plant	3.5	708 B	7196	907		pH range 8.0-8.2 Alkalinity 2426	Average for once per week sampling
Hooker Chemical Niagara Falls	38.7			35,969		Total organics 2085 phenols 256 chlorides 92,146 pH range 7.6-12 mercury 1-2	Total of all direct discharges to Niagara River
Hooker Durez	1.0	10,000 B		1000		Phenol 1000	
International Paper	12	25,800 B		45,200		pH range 6.4-11.0 Avg. 8.5	Information from Waste Water Facility Report 8/26/70
Mobil Oil	26				1500	Phenol 380 Ammonia 800 Sulfide 1500	Information from Waste Water Facility Report 9/28/70
Republic Steel	12	6000 C		16,300	900	Iron 5700 phenol 10	
Stauffer Chemical	1.65	2886 C	225,000	6,160		pH 11.8 10.3 95% confidence NaCl 173,000 $NaSo_4$ 34,100 NaOCl 2800 Alkalinity 27,700	Results of sampling first 9 months 1969

TABLE I

MUNICIPAL & INDUSTRIAL WASTE SOURCES
AFFECTING THE NIAGARA RIVER FROM U.S.

Name	Flow (MGD)	Oxygen Demand (#/day)	Solid		Extractables (#/day)	Others (#/day)	Remarks
			Total (#/day)	Susp.			
Tonawanda Iron	3.55	160 B		1400			Results of samples taken daily during January 1969.
Dunlop	3.05			800	210		Results of weekly samples January, February 1971.
FMC Corporation	10.1	522 B	12,340	-	-	Alkalinity 26,800 Ammonia 964 Sulphates 3,240	Results of weekly sampling April-July, 1971.

Code:

B - Biochemical Oxygen Demand
C - Chemical Oxygen Demand

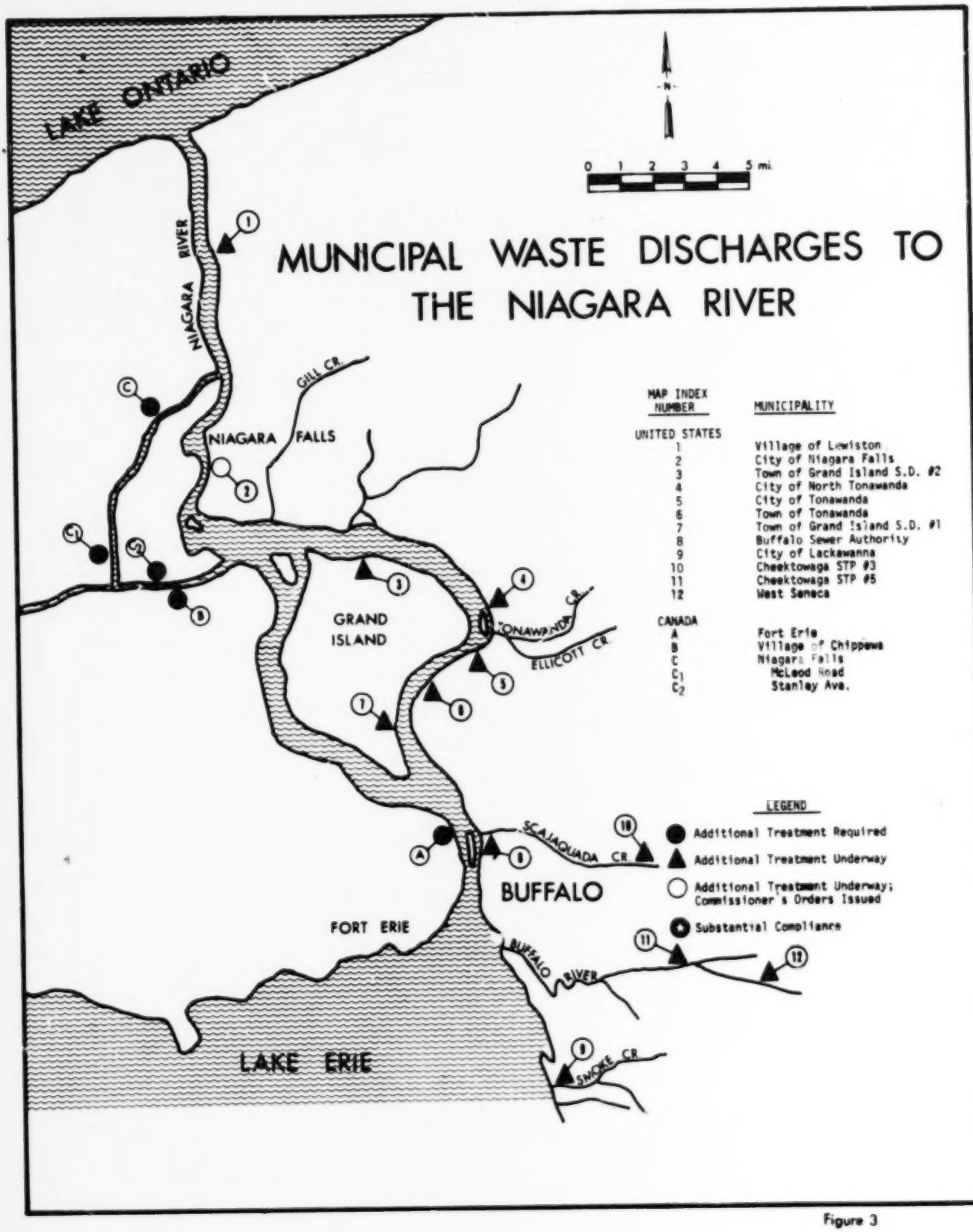

LAKE ONTARIO
NIAGARA RIVER
GILL CR.
NIAGARA FALLS
GRAND ISLAND
TONAWANDA CR.
ELLICOTT CR.
SCAJAQUADA CR.
BUFFALO
FORT ERIE
BUFFALO RIVER
SMOKE CR.
LAKE ERIE
N
0 1 2 3 4 5 mi.
MUNICIPAL WASTE DISCHARGES TO THE NIAGARA RIVER
MAP INDEX NUMBER
MUNICIPALITY
UNITED STATES
1 Village of Lewiston
2 City of Niagara Falls
3 Town of Grand Island S.D. #2
4 City of North Tonawanda
5 City of Tonawanda
6 Town of Tonawanda
7 Town of Grand Island S.D. #1
8 Buffalo Sewer Authority
9 City of Lackawanna
10 Cheektowaga STP #3
11 Cheektowaga STP #5
12 West Seneca
CANADA
A Fort Erie
B Village of Chippewa
C Niagara Falls
C1 McLeod Road
C2 Stanley Ave.
LEGEND
Additional Treatment Required
Additional Treatment Underway
Additional Treatment Underway; Commissioner's Orders Issued
Substantial Compliance

Figure 3

TABLE II

MUNICIPAL POLLUTION ABATEMENT STATUS-NIAGARA RIVER
NEW YORK STATE

Waste Source (Map Index)	Existing Treatment Type	Existing Treatment Volume MGD	Abatement Status Present	Abatement Status Estimated Completion Date	Comments
Buffalo Sewer Authority (8)	Primary	145	Final Plans being prepared	July 1974	An engineering report describing secondary treatment and phosphorus removal has been approved by New York State. Final plans are presently being prepared. Construction to begin by March 1972.
Grand Island S. D. #1 and S. D. #2 (7)	Primary	S.D.#1 .387 S.D.#2 .268	Eng. Report Approved	June 1973	A revised wastewater facilities report was necessary to clarify future development, alternate and phosphorus removal facility design. Final plans to be submitted 8/71.
City of Lackawanna (9)	Primary	3.6	Eng. Report under review	Dec. 31, 1974	Preparing Report to evaluate upgrading of existing plant vs. connection to regional system. Have completed report on project to alleviate combined sewage overflows for Third Ward.
Village of Lewiston (1)	Primary	.38	Final Plans being prepared.	November 1973	An engineering report providing for consolidated treatment with the Village of Youngstown, Town of Lewiston and Town of Porter has been approved. Portions of final plans are under review.

TABLE II

MUNICIPAL POLLUTION ABATEMENT STATUS-NIAGARA RIVER
NEW YORK STATE

Waste Source (Map Index)	Existing Treatment		Abatement Status		Comments
	Type	Volume MGD	Present	Estimated Completion Date	
City of Niagara Falls (2)	Preliminary	73	Eng. Report Approved Final Plans being prepared	December 1974	An engineering report describing physical-chemical treatment for combined municipal-industrial wastes has been approved by New York State. The report is being forwarded to federal authorities for review. Portions of final plans under review.
City of North Tonawanda (4)	Primary	6.4	Eng. Report being prepared	November 1973	An engineering report describing upgrading existing plant to secondary treatment and phosphorous removal has been submitted (Dec. 1970). The report, which was reviewed by New York State, included provisions for treating wastes from Durez and Tonawanda Iron. The report has been returned for further development.
City of Tonawanda (5)	Primary	5.5	Eng. Report approved Final Plans being prepared	December 1973	A report describing collection of wastes in the City and facilities for pumping the wastes to the Town has been approved. The report includes provisions for pumping the wastes from Spaulding Fibre. (See Town of Tonawanda). Final Plans are now being prepared.
Town of Tonawanda (6)	Primary	12.8	Eng. Report approved. Final plans being prepared	December 1973	An engineering report describing collection and treatment of wastes for City and Town of Tonawanda and the Village of Kenmore has been approved by New York State. Construction to begin by March, 1972.

TABLE II

MUNICIPAL POLLUTION ABATEMENT STATUS-NIAGARA RIVER
NEW YORK STATE

Waste Source (Map Index)	Existing Treatment		Abatement Status		Comments
	Type	Volume	Present	Estimated Completion Date	
Town of Cheetowga #3 (10)	Secondary	1.6	Engineering Report being prepared	June 1, 1973	A detailed engineering report evaluating alternates of expanding and upgrading of treatment plants (including phosphorous removal) or connecting to the City of Buffalo is being prepared.
Town of Cheetowga #5 (11)	Secondary	9.0	Engineering Report being prepared	Oct. 1, 1974	New York State has instituted legal action in an effort to accelerate corrective measures.
Town of West Seneca #6 (12)	Imhoff Tank	1.5	Engineering Report under review	Nov. 1974	An engineering report evaluating alternates of connecting to the City of Buffalo or Erie County Sewer District No. 4 is under review. An engineering report of sewer infiltration and overflow problems is being prepared. New York State has taken legal action.

TABLE III

INDUSTRIAL - INSTITUTIONAL POLLUTION ABATEMENT STATUS
NIAGARA RIVER

Waste Source (Map Index)	Present Discharge		Abatement Status		Comments
	Flow (MGD)	Undesirable Contaminants	Present	Est. Compl. Date	
Allied Chemical Buffalo Chemical Plant (25)	9		No program		Water used is primarily for cooling purposes. Routine sampling program indicates that the discharge is acceptable. The quality characteristics of the effluent is very similar to that of the intake.
Allied Chemical Buffalo Dye (25)	24	Solids Color Phenol Mercury	Pretreatment facilities completed	7/71	All contaminated wastes to be pretreated then discharged to Buffalo Sewer Authority. Recent strikes at plant and by construction works delayed construction. Pretreatment facilities are now completed and being evaluated. The remaining discharges are also being evaluated.
Allied Chemical Plastics Division (17)	5		No program		
Allied Chemical Semet Solvay Div. (16)	12	Phenols Solids Ammonia COD Cyanide Oil	Report approved, working on final plans	12/73	Contaminated wastes amounting to approximately 200,000 gpd from by-product operations were included in the pilot plant study by Town of Tonawanda, for possible discharge to the proposed Town system.

TABLE III

INDUSTRIAL - INSTITUTIONAL POLLUTION ABATEMENT STATUS
NIAGARA RIVER

Waste Source (Map Index)	Present Discharge		Abatement Status		Comments
	Flow (MGD)	Undesirable Contaminants	Present	Est. Compl. Date	
Ashland Oil (15)	20	Ammonia Phenol Oil	Facilities operating satisfactorily. Emergency pond completed 6/71.	7/71	Completed air flotation treatment unit on schedule. Oil and phenol removals now satisfactory as a result of installation of chemical feed system to air flotation unit. An emergency holding pond has been constructed as a safeguard against oil spills. Substantial compliance with present New York State and I.J.C. requirements.
Bethlehem Steel	350	Solids Oil Phenol Cyanide Temp.	Under construction	6/71	Delays have been encountered due to strikes by construction workers. However, the following facilites, namely for 8" & 10" bar mill, 45" slabbing mill, 79" hot strip mill, BOF and blast furnace, south structural mills, and north structural mills are completed and have Permits to Operate. It is anticipated that in the near future all the remaining facilities will be completed and Permits to Operate be issued. Cooling water outfalls not yet under permit.
Carborundum	17	Solids	Eng. report approved	4/1/73	Feasibility report submitted November 1970 with decision to construct own treatment facilities. An engineering report has been approved. Construction to begin by January 1, 1972.
Chevrolet Division General Motors (19)	29	Solids Oil Temp.	Eng. report approved Final plans being prepared	12/73	Routine monitoring program indicates the effluent to be acceptable by present New York State and I.J.C. standards. However, the firm has requested that the treated oily wastes be included in the pilot plant study by the Town of Tonawanda for possible discharge to proposed municipal treatment facilities.

GPO 824-738-6

TABLE III

INDUSTRIAL - INSTITUTIONAL POLLUTION ABATEMENT STATUS
NIAGARA RIVER

Waste Source (Map Index)	Present Discharge		Abatement Status		Comments
	Flow (MGD)	Undesirable Contaminants	Present	Est. Compl. Date	
American Malting (23)		BOD Solids Color pH	In planning stages by B.S.A.		The Buffalo Sewer Authority is pursuing a plan for construction of an interceptor sewer to serve this and other similar plants in the area.
Columbus McKinnon (11)	0.29	Thermal	Abated		Firm eliminated toxic and contaminated wastes in 1969. Now have two acceptable cooling water effluents.
Continental Can (12)		Solids	Ceased operation		The firm had been participating in a joint program with the City and Town of Tonawanda. However, the plant ceased operations December 1970.
Donner Hanna (24)	8	Phenols Ammonia Oil Thermal Cyanide	Construction completed	7/71	Numerous in-plant modifications and additions have put the plant in substantial compliance with New York State requirements. Ammonia was a problem; however, reinstallation of lime leg in ammonia still rectified this problem. In addition, recent modifications of the outfall stucture are being evaluated for effectiveness in reducing thermal problem. Operating results indicate other parameters acceptable by present New York State and I.J.C. standards.
Dupont Electrochemicals (5)	42	COD Chlorides Solids	In plant reduction		Negotiations with the City completed and decisions made as to disposition of wastes. Wastes discharging directly to river will be subsequently evaluated.

TABLE III

INDUSTRIAL - INSTITUTIONAL POLLUTION ABATEMENT STATUS
NIAGARA RIVER

Waste Source (Map Index)	Present Discharge		Abatement Status		Comments
	Flow (MGD)	Undesirable Contaminants	Present	Est. Compl. Date	
Dupont Film (19)	3.5	BOD Tot. Solids Alkalinity	No program		Since 1968, the plant has eliminated the production of cellophane and polyethylene and has also made numerous in-plant modifications. This has resulted in a significant reduction of contaminants. The acceptability of the discharge is presently being evaluated.
FMC Corporation (18)	10	Minimal dissolved solids	No program		The firm has recently constructed sampling stations for routine collection and analysis of effluent samples. It is in substantial compliance with present New York State and I.J.C. standards.
General Mills (21)		BOD Solids	Planning stages by Buffalo Sewer Authority		The Buffalo Sewer Authority is pursuing a plan for construction of an interceptor sewer to serve this and other plants in the area.
Hanna Furnace (28)	26	Solids	No program		Have treatment facilities. Routine testing program has been established to evaluate discharge.
Hooker Chemical Durez Division (9)	1.0	Phenols BOD Solids	Engineering report under review	11/73	The firm will discharge their wastes to the proposed North Tonawanda system. A pilot study has been made and a wastewater facilities report was submitted December 28, 1970. The system is scheduled for start of construction March 1972.

TABLE III

INDUSTRIAL - INSTITUTIONAL POLLUTION ABATEMENT STATUS
NIAGARA RIVER

Waste Source (Map Index)	Present Discharge		Abatement Status		Comments
	Flow (MGD)	Undesirable Contaminants	Present	Est. Compl. Date	
Hooker Chemicals Niagara Falls (6)	42	Solids Phenol Chlorides Organics Mercury	Control measures in various stages		Has completed some and is progressing with other control measures. Drilled a waste disposal well but is supplanting this with recovery and HCI manufacture. Expediting further mercury reduction. Numerous processes which generated phenol have been shut down. In addition, a contract has been signed with the City to discharge 10 MGD to the proposed municipal system. Routine sampling program has been implemented; data is submitted monthly.
International Paper (10)	12	Solids BOD pH	Final plans being prepared		The company decided in May 1970 that it would be more feasible to construct an independent treatment facility rather than pursue a joint project with N. Tonawanda. A wastewater facilities report proposing methods of treatment was approved in January 1971. Scheduled for completion of construction by March 1972.
Mobil Oil (27)	26	Phenols Ammonia Sulfides Oil pH	Construction completed	7/15/71	Lack of compliance with Commissioner's Order resulted in a trial and issuance of a court order which called for start of construction by December 1, 1970 and complete construction by July 15, 1971. Construction began by December 1, 1970. New treatement facilities being evaluated.
Niagara Mohawk Power Corporation (18)	lagoons 1.2 cooling 835	Possible solids & thermal problems	Investigation		The plant has two lagoons (.58 MGD each) to remove bottom ash. Routine sampling program for solids is presently being implemented. A study is also underway to determine the effect dredging the lagoons has on solids discharge. Daily measurement of temperature and flow of cooling water is also being implemented.

TABLE III

INDUSTRIAL - INSTITUTIONAL POLLUTION ABATEMENT STATUS
NIAGARA RIVER

Waste Source (Map Index)	Present Discharge		Abatement Status		Comments
	Flow (MGD)	Undesirable Contaminants	Present	Est. Compl. Date	
Niagara University (2)		Sanitary wastes	Engineering report approved Final plans being prepared	11/72	Included in Town of Lewiston Project, for which a wastewater facilities report has been approved.
Olin Chemicals	5	Chlorides Solids Mercury	Under construction		
Pillsbury	.022	Sanitary	Planning stages by Buffalo Sewer Authority		A secondary treatment plant for sanitary wastes was completed in June 1970. This plant will be abandoned when public sewers are made available by the Buffalo Sewer Authority.
Republic Steel (26)	23	Solids Oil Iron Acids	Under construction	12/71	Treatment facility for bar mills was completed and a permit to operate issued on 7/14/70. Facility for blooming mill, blast furnace and BOF is under construction with anticipated completion 12/71. Spent pickle liquor is collected and hauled to a dump for neutralization and disposal.
Spaulding Fibre (13)	4.4	Solids BOD	Engineering report approved Final plans being prepared	12/73	A report describing alternate treatment methods was prepared in 1969, the firm decided in October 1969 to enter a joint project with the City and Town of Tonawanda. An engineering report describing collection and treatment for the Town and City was approved by New York State. The firm is presently working to reduce flow and concentration of contaminants.to be discharged to municipal system.

TABLE III

INDUSTRIAL - INSTITUTIONAL POLLUTION ABATEMENT STATUS
NIAGARA RIVER

Waste Source (Map Index)	Present Discharge		Abatement Status		Comments
	Flow (MGD)	Undesirable Contaminants	Present	Est. Compl. Date	
Stauffer Chemical (1)	1.65	Solids	Engineering report being prepared	1/73	Some in-plant changes have been made to reduce the amount of solids discharged. However, greater reductions will be required. A wastewater facilities report describing treatment and in-plant modifications to be submitted by 10/1/71.
Tonawanda Iron (8)	3.5	Solids pH	Engineering report being prepared	11/73	The firm has expressed their desire to discharge contaminated wastes to the proposed City of North Tonawanda sewage treatment facilities. The remaining uncontaminated cooling water will continue to be monitored and discharged to the Niagara River. A wastewater facilities report from the City was submitted December 28, 1970 and the system is scheduled for start of construction by March 1972.
Boundary Paper	1.0	Solids B.O.D.	Engineering report under review	11/73	Formerly known as Electric City Paper which was under Commissioner's Orders and closed down February 1970. Reopened under name and ownership June 1970. Will discharge to proposed City of North Tonawanda system.
F&M Schaefer Brewing Company		Solids B.O.D. Sulfides	Inplant piping changes and operation being made.	8/72	Will separate uncontaminated cooling from process water which will be discharged to Buffalo Sewer Authority.

TABLE III

INDUSTRIAL - INSTITUTIONAL POLLUTION ABATEMENT STATUS
NIAGARA RIVER

Waste Source (Map Index)	Present Discharge		Abatement Status		Comments
	Flow (MGD)	Undesirable Contaminants	Present	Est. Compl. Date	
Worthington Corporation		Solids Thermal Oil pH	Engineering report being prepared	7/73	The firm has been cited for discharging oil on numerous occasions and for discharging alkaline materials which resulted in fish kill. Presently under litigation which may result in fines and issuance of Commissioner Order.
Dunlop Tire and Rubber Corporation	3.1	Solids Oil Phenol	Engineering report being prepared	12/72	The firm has a routine program for sampling their effluent. Accidental spills of phenols, oil and solids have prompted a voluntary abatement program. An engineering report submitted in May has been returned for further development.

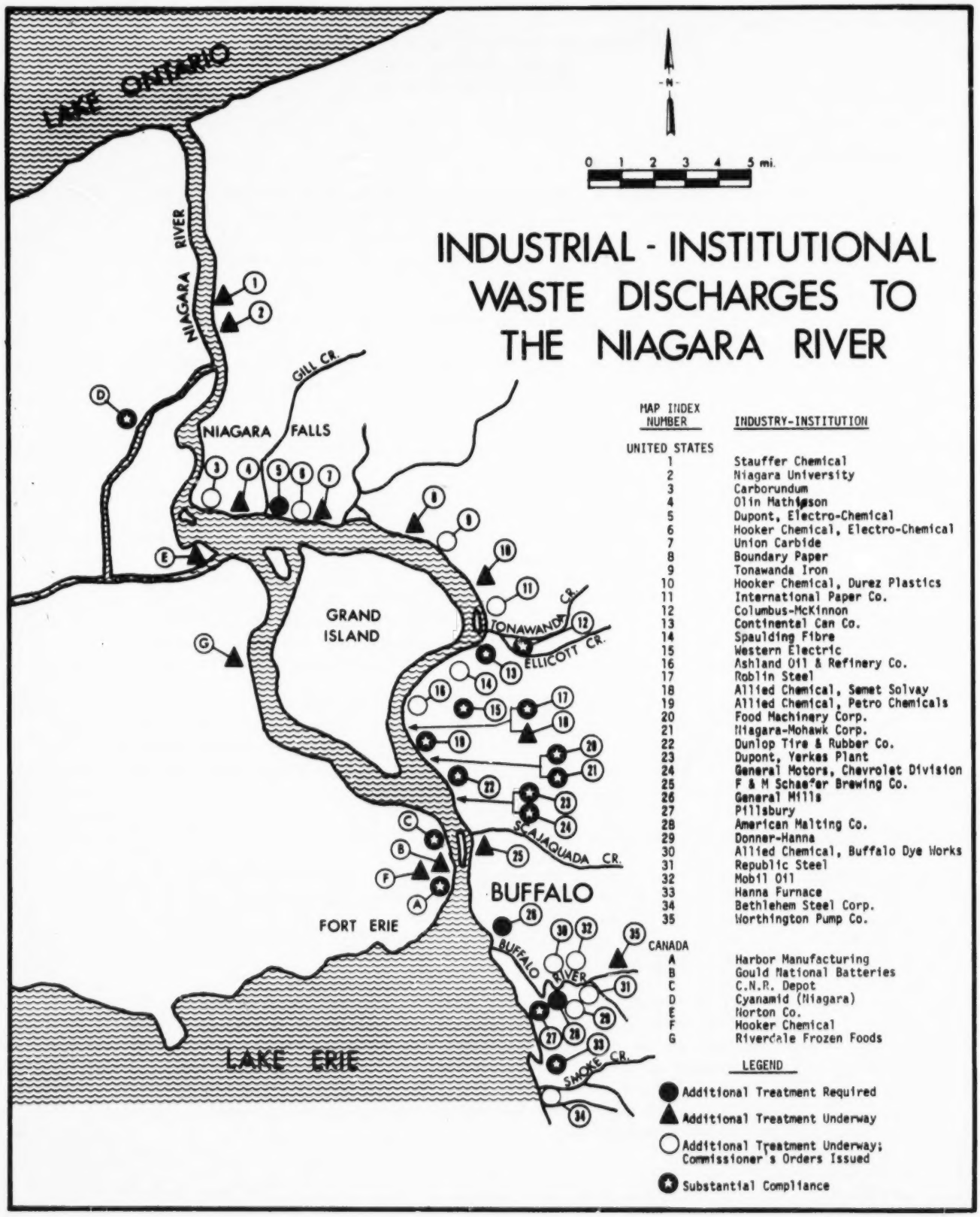

LAKE ONTARIO
NIAGARA RIVER
GILL CR.
NIAGARA FALLS
GRAND ISLAND
TONAWANDA CR.
ELLICOTT CR.
SCAJAQUADA CR.
BUFFALO
FORT ERIE
BUFFALO RIVER
SMOKE CR.
LAKE ERIE
N
0 1 2 3 4 5 mi.
INDUSTRIAL - INSTITUTIONAL WASTE DISCHARGES TO THE NIAGARA RIVER
MAP INDEX NUMBER
INDUSTRY-INSTITUTION
UNITED STATES
1 Stauffer Chemical
2 Niagara University
3 Carborundum
4 Olin Mathieson
5 Dupont, Electro-Chemical
6 Hooker Chemical, Electro-Chemical
7 Union Carbide
8 Boundary Paper
9 Tonawanda Iron
10 Hooker Chemical, Durez Plastics
11 International Paper Co.
12 Columbus-McKinnon
13 Continental Can Co.
14 Spaulding Fibre
15 Western Electric
16 Ashland Oil & Refinery Co.
17 Roblin Steel
18 Allied Chemical, Semet Solvay
19 Allied Chemical, Petro Chemicals
20 Food Machinery Corp.
21 Niagara-Mohawk Corp.
22 Dunlop Tire & Rubber Co.
23 Dupont, Yerkes Plant
24 General Motors, Chevrolet Division
25 F & M Schaefer Brewing Co.
26 General Mills
27 Pillsbury
28 American Malting Co.
29 Donner-Hanna
30 Allied Chemical, Buffalo Dye Works
31 Republic Steel
32 Mobil Oil
33 Hanna Furnace
34 Bethlehem Steel Corp.
35 Worthington Pump Co.
CANADA
A Harbor Manufacturing
B Gould National Batteries
C C.N.R. Depot
D Cyanamid (Niagara)
E Norton Co.
F Hooker Chemical
G Riverdale Frozen Foods
LEGEND
Additional Treatment Required
Additional Treatment Underway
Additional Treatment Underway; Commissioner's Orders Issued
Substantial Compliance

Figure 4

PROGRAMMES IN EFFECT TO ABATE POLLUTION
IN THE NIAGARA RIVER
PROVINCE OF ONTARIO

Water Quality Control

In mid 1970, the Ontario Water Resources Commission published its Guidelines and Criteria for Water Quality Management in Ontario; this statement of policy sets forth the framework for the future control of water quality in the province. The use of water for the assimilation and dilution of treated waste effluents must take into consideration protection of the various water uses including a healthy balance of fisheries and wildlife consistent with sound ecological principles. The water quality criteria comprise the available scientific knowledge of the quality requirements for various uses of water including public, agricultural and industrial water supply, recreation, aesthetic enjoyment and the needs of fish and wildlife. The criteria are used to establish water quality standards for drainage basins or parts thereof, especially where there may be disagreements over water use objectives.

Requirements for effluents and land drainage based on the applicable water quality standards, or the criteria where such standards do not exist, are being established by the Commission in the waters of the Great Lakes basin in order to maintain acceptable water quality. The objective is to reduce existing pressures caused by pollution loads to levels consistent with the desired level of water quality and thereby increase its availability for other useful purposes. More stringent methods of control and/or treatment of waste inputs and land drainage may become necessary as the use of water changes or increases, or as standards are redefined.

Water of a higher quality than that required by the standards will be maintained at this level unless an alteration of the quality is consistent with the protection of all uses. Any such change in water quality standards will take into account public interest and hearings will be held in areas affected by changes in water use.

Assistance to Municipalities

Municipalities may enter into a contract with the Ontario Water Resources Commission for the construction of sewage works under two alternative methods of financing:

a. OWRC-Municipal Programme

Under this method of financing all administrative details associated with securing Ontario Municipal Board approval and establishing rating structures are handled by the OWRC. If a portion of the works are eligible for Central Mortgage and Housing Corporation financing, the balance of the cost may be financed over a period up to thirty years by the Province of Ontario.

GPO 824-758-5

b. Provincial Programme

Under this method the works are owned in perpetuity by the Province of Ontario with financing of eligible portions by CMHC and the balance of the Province of Ontario. The costs financed by the province are amortized over a period of 40 years with the CMHC loan expanded for a term of 40 years as well, operating costs are recovered by a rate based on usage.

In 1969, the Ontario Government introduced a programme to provide assistance for small municipalities experiencing very expensive installation costs for sewage works. In addition, the province provides financial assistance for regional schemes to cover the cost of oversizing main trunk facilities to meet the needs of future development. Where the charge per typical home exceeds $100 per year for water and/or $120 per year for sewage, the Province of Ontario will provide financial assistance up to 50 percent of the total capital cost of the works.

Phosphorus Control Programme

In Canada, the Federal Government has under a provision of the Canada Water Act restricted the level of phosphates in laundry detergents manufactured or imported into Canada. The regulation limits the phosphorus contents of these products is, production to 20% by weight expressed as phosphate pentoxide (8.7% by weight expressed as elemental phosphorus) effective August 1, 1970. Canadian ministers have publicly announced their intention to seek a further reduction of phosphate in detergents to a level of 5% by 1972.

The IJC has recommended that the remaining phosphorus in municipal and industrial waste effluents discharging to Lake Erie, Lake Ontario, their tributaries and the international St. Lawrence River be reduced by at least 80% of their current levels by 1975 and thereafter to the maximum extent possible by economical waste treatment processes. In keeping with this recommendation, the OWRC will implement a programme whereby the controllable sources of phosphorus and other significant nutrients from municipal, industrial and land drainage will be managed to meet the overall objectives of the IJC. In implementing this policy, priority will be given to municipal waste discharges greater than 1 mgd and industrial sources with a significant phosphorus loading.

Enforcement Programmes and Hearings

The Ontario Resource Commission Act provides the authority by which the commission carries out the enforcement programs in Ontario. The commission maintains monitoring and surveillance of the waters in the drainage basins of the Province. Inventories are maintained of municipal, industrial and other sources of pollution in relation to trends in water quality. Evaluations are made of the quality of water for water supply and waste-water discharge purposes. In addition, the commission reviews and approves

plans for municipal water and sewage works as well as industrial waste treatment facilities. The Commission constructs and operates water and sewage works for municipalities and inspects all facilities to determine efficiency of operation and maintenance and complies with effluent requirements.

Where acceptable pollution control programs including schedules of abatement are not presented to the commission, the punitive provision of the act may be used against an offender. These include fines to industries, municipalities and persons for discharging polluting materials into water accidentally or otherwise; orders to industries and municipalities requiring them to report, design, construct and operate treatment facilities in certain stipulated time intervals; requirements for industry to report all acceptable discharges that might reach a water course; restraining expansion of municipalities where sewage works programs are inadequate; regulations for control of sewage from pleasure craft; and regulations for proper use of pesticides when applied to the aquatic environment.

In Ontario, hearings are employed to examine publicly important local municipal and industrial developments, the extension of municipal water and sewage services into adjacent municipalities and definition of areas for public water and sewage service. The OWRC expects to make increased use of hearings in setting water quality standards and developing plans for water quality control.

Contingency Planning for Handling of Spills

In consultation with other government agencies a province-wide Contingency Plan for the handling of emergencies arising from spills of oil and hazardous materials has been developed by the OWRC. The Ontario Operations Centre, located in the offices of the OWRC, acts as the focal point for all reports concerning spills; maintains up-to-date technical information on combating spills and an inventory of materials, chemicals, etc. to be used for control purposes, and authorizes the implementation of the Ontario Contingency Plan in the event of a major spill.

The Ontario Contingency Plan emphasizes responsible procedures for major spills in the Great Lakes system and operates in conjunction with the International and Interim Canadian-Federal Contingency Plan which has recently come into effect.

Marina and Boating Legislation

Boating regulation covering disposal of sewage and garbage from boats became effective January, 1969. The regulation applies to all boats used for pleasure and prohibits the discharge of sewage or garbage into Ontario waters. Sewage pump-out facilities are required at marinas and yacht clubs serving pleasure boats equipped with heads.

Disposal of Dreding Spoil

In co-operation with the Canada Department of Public Works and Transport, the OWRC examines and classifies sediments to be dredged to avoid

unnecessary pollution from dredging operations. Those sediments that are likely to cause deterioration in water quality through open lake dumping are designated for alternate disposal on land or behind diked areas.

Herbicides and Pesticides

In supporting the recommendation that substitutes be found for persistent toxic pesticides and herbicides, the OWRC draws on experience gained in its aquatic nuisance control programme. It will be necessary that improved control of chemicals applied to the lands of the drainage system be developed to avoid serious and persistent pollution of the Great Lakes from these chemicals. In Ontario, DDT, aldrin, dieldrin and heptachlor have been banned for general use since January 1, 1970.

Surveillance on the River

In addition to its regular inventory and water use evaluation programmes, the Commission maintains regular aerial and vessel surveillance patrols on the upper and lower Niagara River. During 1970, this work included four sampling runs on the upper river and five runs in the lower river. Sampling is carried out at the following Niagara River Ranges: Ni 37.7, Ni 34.3, Ni 32.5, Ni 26.7, Ni 20.0, Ni 19.4, Ni 6.8, Ni 2.4, and Ni 1.0.

Monitoring of municipal and industrial waste discharges in the Great Lakes basin is maintained and correlated with the receiving water data. The selection of parameters for examination is based on providing characterization of wastes as they affect water quality.

MUNICIPAL AND INDUSTRIAL POLLUTION ABATEMENT STATUS
PROVINCE OF ONTARIO

MUNICIPAL

The municipal structure of the Niagara Peninsula (Lincoln and Welland counties) has been changed, effective January 1, 1970. This area is now known as the "Regional Municipality of Niagara". The municipalities bordering on the Niagara River are: the Town of Fort Erie, the City of Niagara Falls and the Town of Niagara-on-the-Lake. Details of the waste loadings discharged to the Niagara River from municipalities in Ontario are presented in Table VI and the municipal abatement measures is shown in Table V.

Town of Fort Erie

The primary plant serving the Town of Fort Erie was constructed in 1963 under a financial agreement with the OWRC.

The plant is operating efficiently and receives an average flow of 1.6 mgd which is approaching the hydraulic capacity of the plant. Discussions have been held with municipal officials concerning expansion of this plant to meet future requirements, including wastes from annexed areas which are presently unsewered.

City of Niagara Falls

The City of Niagara Falls is presently served by a primary plant with a 10 mgd capacity that was constructed in 1963. The plant presently receives waste flows at a rate of about 6.7 mgd. Through recent amalgamation, the City has also acquired the activated sludge plant (design capacity 0.3 mgd) serving the former Village of Chippawa. The plant is presently hydraulically overloaded.

Proposals for the elimination of the Chippawa plant have been finalized. This program, which will also include the elimination of the Stanley Avenue and McLeod Road settling tanks has been scheduled for completion by the end of 1971.

Town of Niagara-On-The-Lake

The consulting engineers' report to the OWRC on expansion of the present Niagara on the Lake lagoon and construction of a trunk sewer to service the virgil area with this facility is expected shortly. A proposal will then be presented to the Town and Regional Municipality of Niagara. The effluent from the lagoon will continue to be directed to Lake Ontario. The Regional Municipality is also considering servicing the Queenston and St. Davids area of the Town of Niagara on the Lake with a trunk system to be connected to the City of Niagara Falls plant. These two areas are presently served by septic tank systems.

INDUSTRIAL

Details of waste loadings exceeding OWRC and abatement programs for industries discharging to the Niagara River are presented in Table VI. The progress made in the problem areas previously reported is given below.

Gould National Batteries of Canada Limited - Fort Erie

The Company has isolated the sources of lead from their operations and have completed treatment facilities including a collection and batch treatment system for removal of lead to a satisfactory level.

Norton Company - Chippawa

The Company has submitted for OWRC approval, a treatment proposal for suspended solids and sulphides control. These facilities include neutralization, aeration and sedimentation processes. Construction is on schedule with completion expected by August 71.

Riverdale Frozen Foods Ltd. - Niagara Falls

This Company recently placed into operation facilities for BOD, suspended solids and fat removal. An evaluation of these facilities by the OWRC indicates essential compliance.

Hooker Chemical Nanaimo Limited - Fort Erie

This plant engaged in the production of phenol-formaldehyde resins came into operation in July, 1970. Essentially, only cooling water is discharged, but some problems have been experienced with phenols in the effluent. The two major sources has been pinpointed to the secondary reactor wash waters and a cooling conveyor system. Both these sources have been corrected and will be evaluated during the next routine inspection.

TABLE VI

INDUSTRIAL POLLUTION ABATEMENT STATUS - NIAGARA RIVER
PROVINCE OF ONTARIO

Waste Source (Map Index)	Excessive Waste Constituents in Effluent lbs/day	Abatement Programs Type	Completion Date	Expected Compliance with OWRC Effluent Requirements
Harber Mfg. Ltd., Port Erie (A)		Essential Compliance		---
Gould National Batteries Port Erie (B)	S. Solids 1.3 Lead 0.72	Essential Compliance	March 1971	---
Canadian National Railways Port Erie (C)		Essential Compliance		---
Cyanamid of Canada Ltd. Niagara Falls (D)		Essential Compliance		---
Norton Company Chippawa (E)	S. Solids 5,000 Sulphides 100	Sedimentation and aeration and neutralization for sulphides	August 1971	---
Hooker Chemical Naimo Ltd. Fort Erie (F)	Phenols	Evaluation to be made of recent corrective measures.		---
Riverdale Frozen Foods Niagara Falls (G)	Fats) BOD)variable SS)	Essential Compliance		---

TABLE V
MUNICIPAL POLLUTION ABATEMENT STATUS - NIAGARA RIVER
PROVINCE OF ONTARIO

Waste Source (Map Index)	Existing Treatment	Design Capacity MGD	Abatement Programs Proposed by Municipality		Further Abatement Required	
			Type	Completion Date	Type	OWRC Target Comp. Date
Town of Fort Erie (A)	Primary	1.8	None	-	Phosphorus Removal	1975
City of Niagara Falls						
- Chippawa Plant (B)	Activated Sludge	0.3	See below	-		
- Stamford Plant (C)	Primary	10.0	Elimination of Chippawa plant and collector system extensions	1971-1972	Phosphorus Removal	1975
- McLeod Rd. Settling Tank (C_1)	Settling		Planned interception and connection with city sewage system	1971-1972	-	-
- Stanley Ave. Settling Tank (C_2)	Settling					
Town of Niagara-On-the-Lake	Lagoon (Effluent to Lake Ontario)		Expansion of lagoon to serve Virgil area		-	-
(Virgil)	Individual Septic Tanks		Proposed collector and trunk system with connection to expanded Niagara-on-the-Lake lagoon.		-	-
(St. Davids and Queenston)	Individual Septic tanks		Proposed collector and trunk system with connection to City of Niagara Falls treatment plant		-	-

TABLE VI
INDUSTRIAL POLLUTION ABATEMENT STATUS - NIAGARA RIVER
PROVINCE OF ONTARIO

Waste Source (Map Index)	Excessive Waste Constituents in Effluent lbs/day	Abatement Programs Type	Completion Date	Expected Compliance with OWRC Effluent Requirements
Harber Mfg. Ltd. Fort Erie (A)		Essential Compliance		-
Gould National Batteries Fort Erie (B)	S.Solids 1.3 Lead 0.72	Chemical Treatment & Filtration	March 1971	Yes
Canadian National Railways Fort Erie (C)		Essential Compliance		-
Cyanamid of Canada Ltd. Niagara Falls (D)		Essential Compliance		-
Norton Company Chippawa (E)	S.Solids 5,000 Sulphides 100	Clarifier, Vacuum filtration, Chemical treatment for sulphides	August 1971	Yes
Hooker Chemical Nanaimo Ltd. Fort Erie (F)	Phenols	Segregation of secondary reactor Wash-up water	Spring 1971	Yes
Riverdale Frozen Foods Niagara Falls (G)	Fats) BOD)variable SS)	Treatment facilities for BOD,SS, fats removal installed	Completed and under evaluation by OWRC	Yes

GPO 824-758-4

EXPECTED IMPROVEMENT IN NIAGARA RIVER WATER QUALITY

The objective of the waste treatment and control projects underway in the Niagara River area is to protect and improve the water quality of the Niagara River and Lake Ontario for beneficial uses. The last of the major pollution reduction measures currently underway should be completed and in operation by December 1975. The water quality conditions that will be attained by the abatement measures now underway is of prime interest. Following is an estimate of the anticipated character of Niagara River water in 1976.

The added secondary and phosphorus removal treatment of all United States municipal discharges to the Niagara River and phosphorus removal by the Canadian Municipalities will materially improve the bacteriological quality of the effluents. This will consistently maintain the coliform concentrations below 1000 organisms/100 ml. with two exceptions. The exceptions are due to the fact that feasible solutions to storm drainage and combined sewer overflow problems have not been developed. Because surface runoff and storm water overflows are major contributors of the coliforms present at the mouth of the Buffalo River, the Black Rock Channel and a limited downstream sector of the Niagara River will have bacterial concentrations above the objective. It may also be anticipated that these latter discharges will cause temporary increases in bacterial contamination of other sectors of the river.

Action is being taken to improve the situation. Consultants of the Cities of Buffalo, Lackawanna and Niagara Falls, New York, are seeking solutions to the problem of overflows from their combined sewer systems. All of the United States Communities have initiated programs to reduce overflows from separate sanitary sewer systems by requiring elimination of all illegal connections to the sanitary sewers such as roof and foundation drains. Programs designed to reduce pollution by the discharges from separate storm water sewers have not as yet been developed.

All of the refineries, coke plants, and other miscellaneous sources of phenol in the Lackawanna, Buffalo, Tonawanda area have in the past instituted phenol recovery or other measures which appreciably reduced the phenol in the upper section of the river. The existing waste phenol in most effluents represents the smaller residuals which are more difficult to remove. New York State is establishing definite maximum quantities to be permitted in each of these individual industrial discharges. It is expected that this further reduction will reduce the quantity of phenol from these sources to concentrations in the river below the IJC objectives following the existing mixing effects of the river flow with two exceptions. Trace phenol may remain in areas immediately below the Buffalo River mouth where mixing proceeds very slowly and immediately downstream of some outfalls above the City of Tonawanda. It is predicted that completion and operation of the waste control and

treatment measures currently in process at North Tonawanda and the City of Niagara Falls will essentially eliminate phenol contributions in the sector from North Tonawanda to the mouth. It needs to be recognized that an occasional actual value obtained by analyses of the river water may exceed the IJC objective since there is some evidence that the commonly used analytical and sampling procedures may not always yield the required accuracy in natural waters at the extremely low concentration of the objectives.

Measures being taken by industry to reduce the oil content of their discharges as well as the improved treatment of municipal wastes will greatly reduce the quantity of oil, fat and grease continuously entering the Niagara River. These actions are expected to reduce but not eliminate the accumulation of appreciable oil films on the slow moving Buffalo River and in the Black Rock Channel area. However, it is also probable that noticeable oil films will be present in the upper Niagara River during periods when accumulated oils are being flushed out of the Buffalo River. The frequency and quantity of objectionable oil accumulations in protected Niagara River shore areas such as marinas will be markedly reduced. Observed improvement this past year indicates the possibility that this type of accumulation may actually be eliminated except for those resulting from accidental spills. Complete elimination of oil pollution in the Niagara River is expected to be difficult. Accidental spills may never be completely eliminated. Continuing enforcement designed to improve preventive measures and effectiveness of cleanup procedures in the event of a spill will be essential.

Some decrease of waste chloride from industrial sources is expected as a result of abatement measures underway. The large quantity in municipal wastes will not be appreciably changed. Reduction of chlorides and dissolved solids will need more attention in the future if the historical increase in these waters is to be interrupted and the total dissolved solids in Lake Ontario be maintained below 200 mg/l.

Although iron concentrations slightly exceed the I.J.C. objective in certain areas along the United States shore, they do not have any identifiable adverse effect on water uses. The improved waste control measures, particularly at the steel plants, will significantly reduce the quantity of iron discharged to these waters. Because most of the iron in these wastes settles or precipitates, it is difficult to estimate the reduction if any that will occur in the overlying waters.

It is anticipated that reduction of phosphorus in municipal plant effluents and the other activities underway will reduce the phosphorus input to Lake Ontario by 2000 short tons or more per year. This will be a major initial step in meeting the I.J.C. objective to protect Lake Ontario. Legislation limiting the phosphorus content has been enacted in Canada (Canada Water Act 1970) and more recently in New York.

The available information indicates that no one industrial waste

discharge direct to the river contains large quantities of phosphorus. The projected treatment of these wastes is therefore not expected to appreciably reduce the total phosphorus input to the Niagara River. Industries are conscious of the problem and some have substituted low phosphate detergents and otherwise eliminated use of phosphorus containing chemicals that may eventually reach their wastes. Identification of the sources and development of solutions to agricultural, general land runoff, sewer overflow and other miscellaneous contributions are not as far advanced.

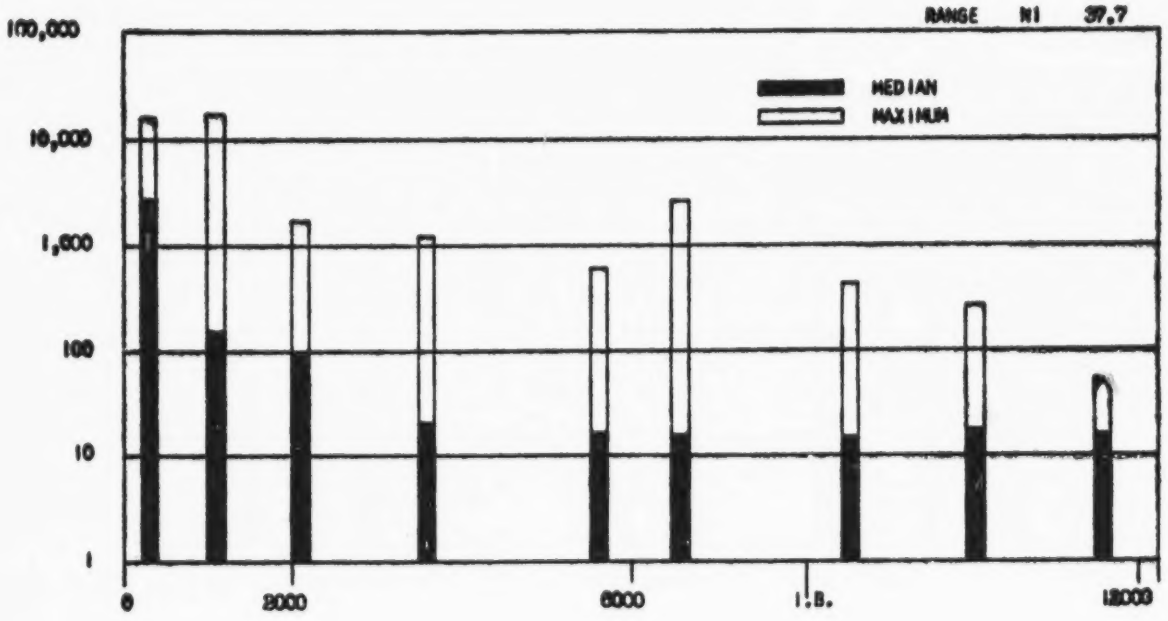
The corrective measures underway will completely eliminate all discoloration of the river at the industrial and municipal sewer outfalls with a possible exception at the International Paper Company. The proposed treatment of paper company wastes will effectively eliminate the primary discoloration due to suspended solids and foam but the treated wastes may have some color. Any color imparted to the river will be limited to the immediate area of the outfall and may not be noticeable. The appearance of Black Rock Channel waters and the inshore portion of the Niagara River immediately below the Buffalo River mouth will only be partially improved. Turbidity will continue to be present in portions of the Niagara River at times. Development and application of measures to reduce land erosion and solve the urban runoff and storm water overflow would help somewhat but only limited or partial solutions are currently available for implementation. It is uncertain that completion of the abatement schedule will significantly change the foam problem below the falls. The chemical odors emanating from the diversion sewer outfall below the falls have been significantly reduced. Further reduction is anticipated but they may not be completely eliminated.

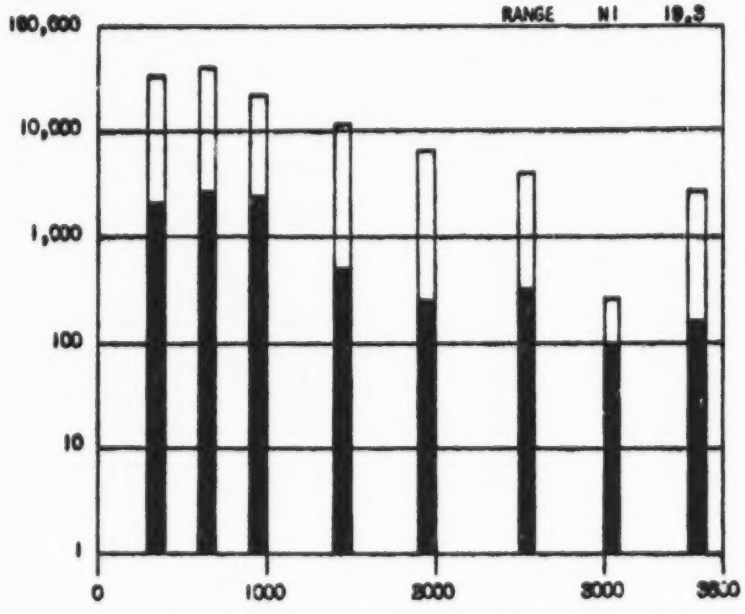
The projected elimination of all existing conditions of river water discoloration at industrial and municipal treatment plant sewer outfalls will be a major accomplishment. These are the situations that are most obvious and objectionable to the public. Only those conditions which may be natural in origin, or for which feasible solutions are not presently available will continue to persist to some degree.

Much of the impairment of benthic populations along the United States shore of the upper river and throughout the lower river is the cumulative result of many waste sources. Inasmuch as all of the major polluting discharges are being improved there will be a better balanced macroinvertebrate population throughout almost all sectors of the river. The seriously disrupted benthic communities at the mouth of the Buffalo River and in the Black Rock Channel will linger to some degree until needed improvements to control surface drainage and sewage overflows are developed and completed.

All of the identified and significant municipal and industrial sources of pollution will be materially reduced by the abatement measures underway in the Niagara area. Completion by 1975 of the scheduled pro-

gram will upgrade the water quality characteristics of the Niagara River. Further improvements in water quality require acceleration of the proposed longer range programs for the control of surface drainage and sewage overflows.





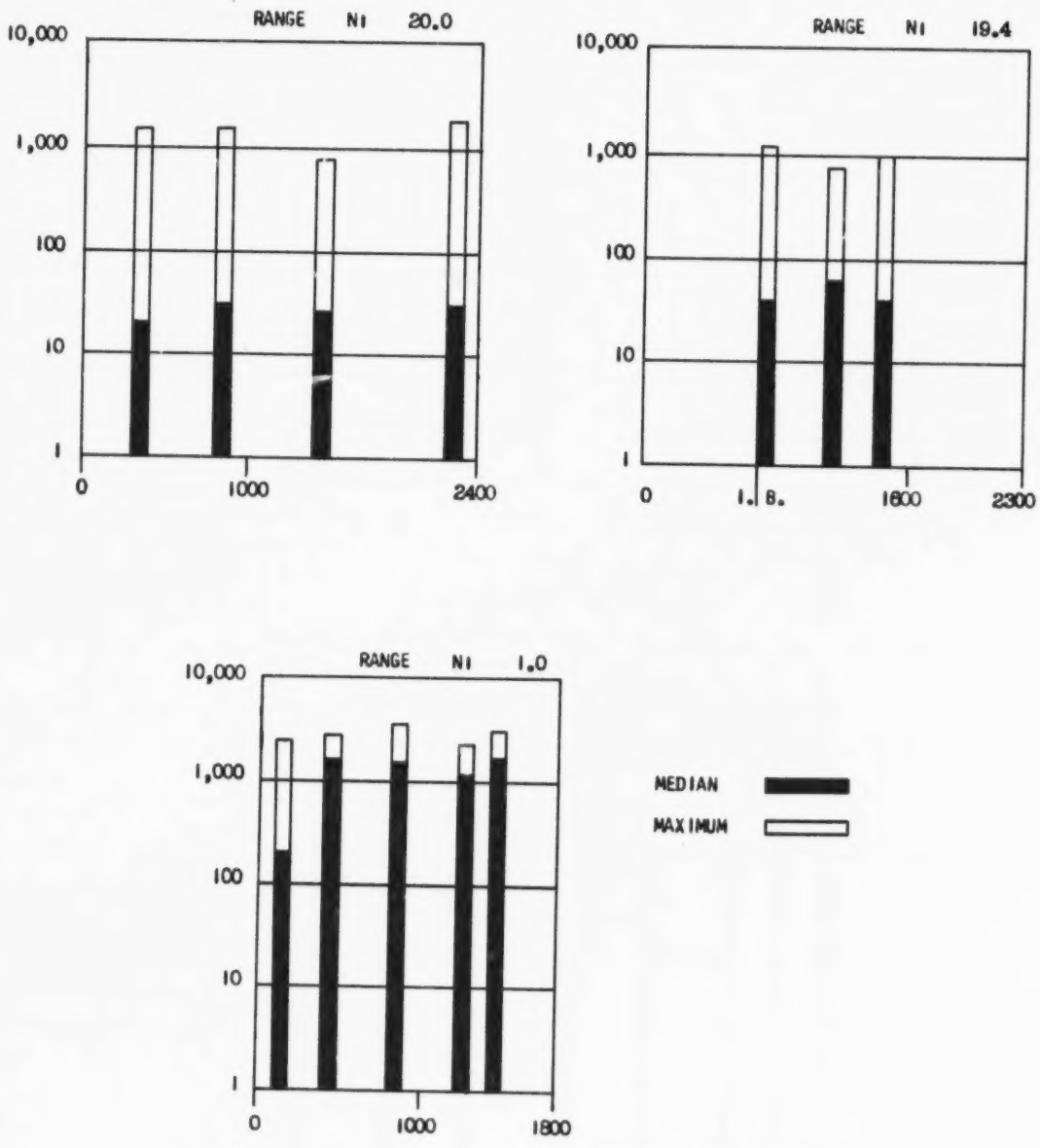
MEDIAN and MAXIMUM COLIFORM DENSITIES

NIAGARA RIVER - 1968 TO 1970 COMBINED DATA

SCALES: HORIZONTAL - IN FEET FROM AMERICAN SHORE AS INDICATED

VERTICAL - COLIFORM, M F PER 100 Ml, AS INDICATED

Figure 5

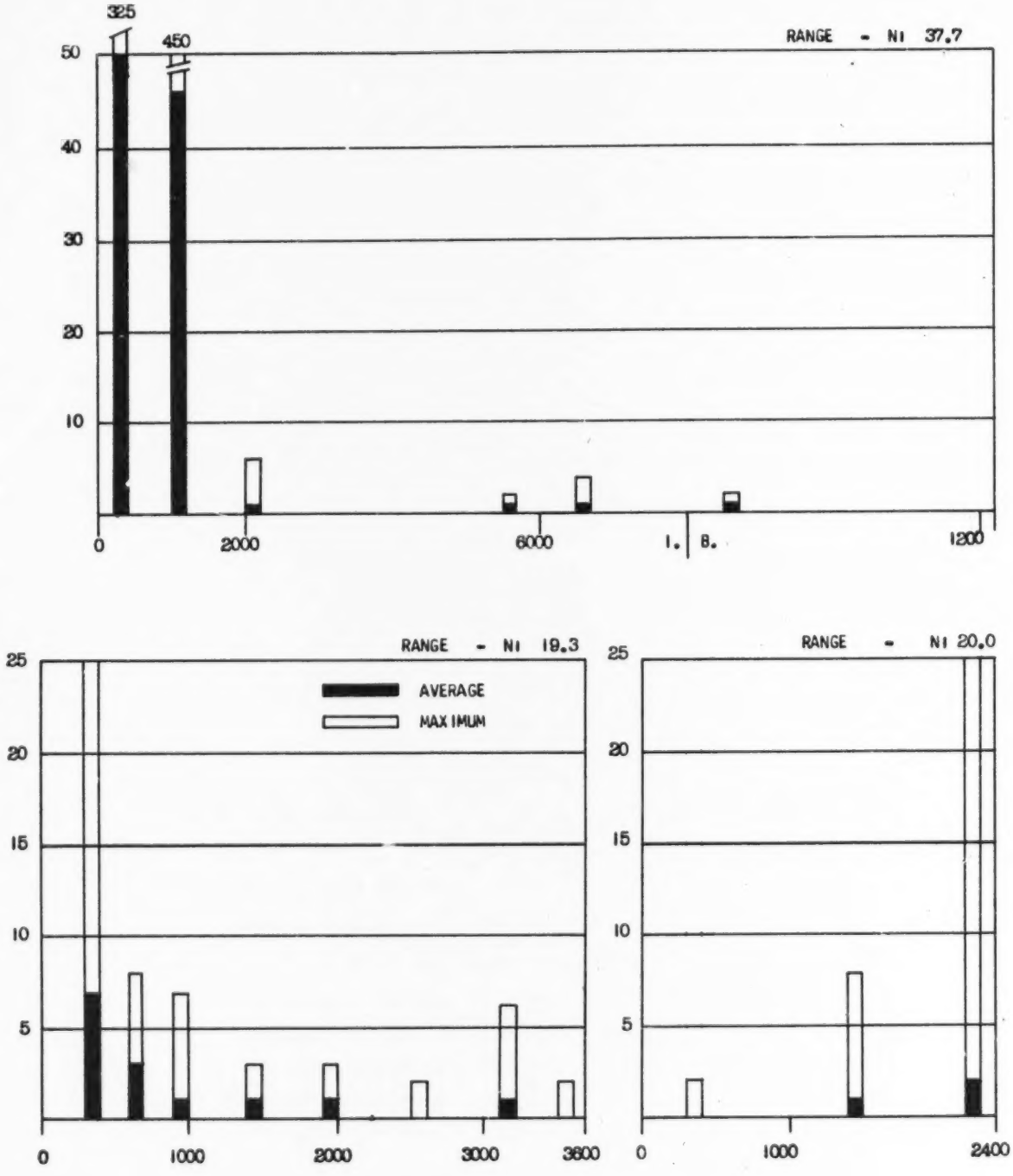


MEDIAN and MAXIMUM COLIFORM DENSITIES

NIAGARA RIVER - 1968 TO 1970 COMBINED DATA

SCALES: HORIZONTAL - IN FEET FROM AMERICAN SHORE AS INDICATED
VERTICAL - COLIFORM, M F PER 100 Ml, AS INDICATED

Figure 6



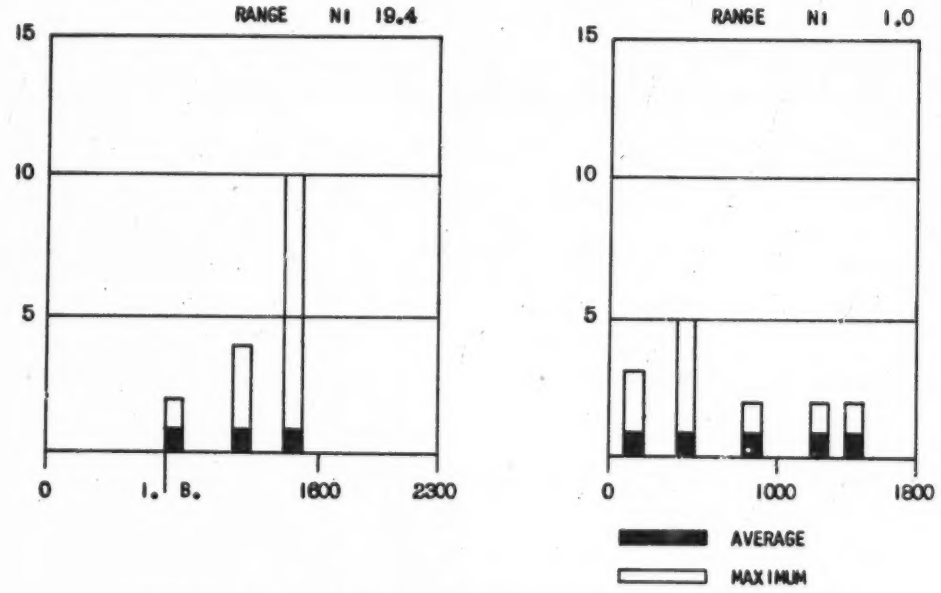
AVERAGE and MAXIMUM PHENOL CONCENTRATIONS

NIAGARA RIVER - 1968 TO 1970* COMBINED DATA

SCALES: HORIZONTAL - IN FEET FROM AMERICAN SHORE AS INDICATED
VERTICAL - PHENOL, PARTS PER BILLION, AS INDICATED.

* 1970 DATA TO THE END OF SEPTEMBER SURVEY.

Figure 7



AVERAGE and MAXIMUM PHENOL CONCENTRATIONS

NIAGARA RIVER - 1968 TO 1970* COMBINED DATA

SCALES: HORIZONTAL - IN FEET FROM AMERICAN SHORE AS INDICATED

VERTICAL - PHENOL, PARTS PER BILLION, AS INDICATED.

* 1970 DATA TO THE END OF SEPTEMBER SURVEY.

Figure 8

GPO 824-758-3